ELECTRICAL REVIEW

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ELECTRICAL REVIEW

6 March 1959 Vol. 164 No. 10 Established 1872

Solving the Problem?

THE vital importance of a sound and adequate system of technical education to our national well-being was emphasised by Mr. S. E. Goodall, President of the Institution of Electrical Engineers, in the speech which he made last week on the occasion of the Institution's annual dinner. It is evident from what Mr. Goodall said (his and the other three speeches are reported in this issue) that technical education is now one of the main interests of the Institution, and quite rightly so.

It is disappointing to record that despite the efforts which have been made to increase the output of trained engineers and scientists from the universities and technical colleges the number still falls rather short of the target. It is clear that still further efforts must be made. The I.E.E. and the larger organisations within the electrical industry have for several years now done everything within their power to see to it that graduate and student apprentices receive an adequate training. The large firms have been more than pulling their weight for many years and it is difficult to see how they can possibly intensify their efforts. The time has come for the smaller firms to help, as they frequently benefit by employing engineers who have received their practical training with large firms. The duty therefore lies with the small firms who have no training programme at all or, at best, provide a specialised training from which only they can benefit. The broad training required by the professional engineer can, however, be obtained by co-operative effort between small firms as exemplified by the group training scheme of the S.E.T.S. (Scottish Electrical Training Scheme). It is a very short-sighted policy on the part of those all too many who view the cost of practical training as a debit only.

Reverting to the universities and technical colleges, we feel that the various programmes of building should be extended to provide better facilities for teaching our young men. There is no doubt that the shortage of teachers reflects on the output of graduates and something might well be done in connection with teachers' salaries, at the same time making their training courses more attractive to men who have spent a few years in industry and have become accustomed to a certain standard of living. At

the I.E.E. annual dinner it was significant to note that all four speakers referred, with enthusiasm, to the projected Delhi College of Science and Engineering Technology, the foundation stone for which was laid by the Duke of Edinburgh in January. Despite our difficulties in this country the British Government considers it a worthwhile proposition to give financial support to the Delhi scheme. British industry is also to be asked to provide £250,000 worth of equipment for the College and most of the teaching staff will be recruited in this country. From what was said at the I.E.E. dinner it is possible that there will be a surplus of graduates when the Delhi College is in full operation and these men will naturally want to find employment elsewhere in the British Commonwealth. It would be one way of overcoming our shortage of graduates by employing them in this country.

B.E.A.M.A.'S DOMESTIC SIDE

For some time past it has been evident that the domestic appliance interests in the British Electrical and Allied Manufacturers' Association were in need of stronger representation. At present the Association has sections dealing with cookers, water heaters, and other domestic appliances, and there is also a committee handling the export problems of these sections as well as technical committees which study matters of design and construction. Negotiations have been known to be proceeding and they are now soon to show results. The B.E.A.M.A. Council informs us that it is in process of establishing a Domestic Appliances Division to co-ordinate the activities of the sections concerned as a means of stimulating the development of the domestic side of the industry. It is intended to make an announcement as soon as the scheme has been completed and approved by the Council.

AMERICAN CONTRACTS

Protests at the award by the Tennessee Valley Authority of a generating plant contract to C. A. Parsons & Co. continue. Last week it was announced that a resolution was being introduced into the House of Representatives calling upon the Authority to submit the matter to the Office of Defense Mobilisation for a ruling as to whether the contract constituted a threat to national security. It also suggests that the Labour Department should be asked to say whether the contract would cause sufficient damage to employment to warrant its cancellation. In the meantime it has been reported that the T.V.A. has placed an order for plant with the Swiss Brown Boveri Co.

The Washington correspondent of *The Times* says that the President was asked last week whether the outcry in Congress and elsewhere would not lead Great Britain to doubt the wisdom of "liberalising" dollar trade. Mr. Eisenhower apparently did not give a direct reply but referred to the high costs of American firms which were making it difficult for them to compete with foreign countries. He did, however, feel that the increasing of import tariffs would be a grave mistake. This is a course which some of the leading American electrical concerns have advocated.

The latest incident in this chain of events is the rejection by the U.S. Army Corps of a tender by the English Electric Co. for hydro-electric generators because it was not "technically responsive to the specifications," although, according to an Army spokesman, it would not have been accepted if it had conformed. The latter statement may have been justified by an insufficient difference between the British and the accepted American tender, under the terms of the Buy American Act, but this was not mentioned.

SELLING NUCLEAR EXPERIENCE

Now that the Japan Atomic Power Company has entered into exclusive negotiations with the General Electric Co., Ltd., for a 150 MW nuclear power station it is to be hoped that prevarication and rumours will cease and that the start of construction will not be unnecessarily delayed. The sale of a nuclear power station is a long and arduous business, and, where several companies are interested, costly to this country in technical effort. The three consortia who tendered for this station have been heavily involved over a period of nearly three years, and the decision to buy British and not American was only assured after a visit by Sir John Cockcroft.

The contract is still to be won. Much depends on the course of the present discussions on technical details and, presumably, price. In both these an important factor is the amount of work to be allocated to each country. If the Italian order is a guide, the split is unlikely to be more favourable than 50 per cent, though the G.E.C. is well placed here by reason of its recent manufacturing agreement with a group of Japanese companies. As we have said before, a contract for a nuclear power station is more a sale of knowledge and experience than of plant that will show in the trade returns. Nevertheless the closer degree of co-operation with the industries of other countries that this involves will surely prove beneficial in the long run.

POWER FROM CHAPELCROSS

On Wednesday of last week the Chapelcross nuclear power station of the United Kingdom Atomic Energy Authority near Annan, Dumfriesshire, fed electrical power into the grid system for the first time. This was just one week ahead of the specified date. The plant at Chapelcross is identical with that installed at Calder Hall, and the buildings are laid out in very much the same fashion. A comprehensive description of Calder Hall was published in our issue of 19th October, 1956.

ELECTRICAL ENGINEERS' EXHIBITION

On Tuesday, 17th March, the eighth Electrical Engineers' Exhibition, organised by the Association of Supervising Electrical Engineers, opens at Earls Court, London. More than 430 manufacturers, associations and other organisations are this year taking part and besides a wide range of industrial and domestic electrical products there will be a special feature on illumination. Next week's issue will contain an illustrated stand-by-stand preview of the Exhibition, which closes on 21st March

Many new plastic materials have been developed in the last few years and the most important are surveyed by the author. Their properties and fields of application are discussed with particular reference to electrical insulation

PLASTICS FOR INSULATION

A Survey of Some Recent Important Developments

FROM A CORRESPONDENT

IN the last few years progress in plastics has accelerated rapidly and many new or improved materials have been developed which are of interest to the electrical and electronic industries. The purpose of this article is to discuss the properties of some of the new plastics and to indicate their fields of application.

The most significant advances in recent years have been in the field of polyolefines, leading to the development of new types of polyethylene, as well as a new polymer, polypropylene. Although it may be several years before the potentialities of these materials are fully realised in industry, there seems little doubt that these new plastics will prove of great value to the electrical engineer, particularly for cable insulation.

As their name implies, the linear polyethylenes have much less " branching " in the molecular chain than conventional polyethylene; because they are highly crystalline they have different mechanical properties from the ordinary material, which is largely amorphous in character. Except for impact strength, the mechanical properties of linear polyethylenes are superior. Their electrical qualities are virtually the same.

Table 1 compares various types of polyethylene. It should be noted that density is a criterion of stiffness; it is also a good measure of temperature resistance and, above densities of 0·935, it is also a measure of the abrasion resistance.

Table 1.—Comparison of Various Polyethylenes

	Bakelite* DYNH	Alkathene HD (I.C.I.)	Carlona (Shell)	Rigidex (B.R.P.)
Density (g/ml) ...	0·918	0·94	0·95	0·96
Melt index, g ...	1·7–2·4	0·8	0·2	0·7
Dielectric constant at 1 Mc/s	2·3	2·32†	2·37	2·35
Power factor at 1 Mc/s	0·0002	0·0002†	0·0005	<0·0001
Volume resistivity, (ohm-cm)	$>1\times10^{17}$	—	3×10^{16}	—
Tensile strength (p.s.i.)	1,800	2,350	2,960	4,200
Impact strength (ft lb/in notch) (injection moulded specimens)	20‡	15·8	5·6	5·4

* A typical low-density polyethylene.
† Estimated figure.
‡ Bent, but did not break.

Melt index is a significant property, since it indicates the impact strength of the material, its resistance to stress cracking, and the ease with which it can be processed. The lower the melt index, and hence the higher the molecular weight, the greater is the crack resistance. However, the lower the melt index, the less easy is the material to process, resulting in lower production.

Molecular weight distribution is also important: the narrower it is, the better is the crack resistance but, again, the material is less easily processed. Generally speaking, polyethylenes of higher density have inferior resistance to stress cracking.

Taking the family of polyethylenes as a whole, and varying the basic parameters of molecular weight, molecular weight distribution and density, a very great variety of properties can be achieved. By blending polyethylenes of varying density, etc., these properties can be varied still further. Again, ethylene can be copolymerised with other hydrocarbons, including olefines such as propylene, thereby extending the range of properties and making the number of possible insulating materials extremely large indeed.

At present, however, the main interest is centred on the exploitation of the various new high density polyethylenes commercially available, namely, Alkathene HD, Carlona and Rigidex. So far, little has been seen of any of these materials in electrical applications and there is evidence to suggest that, in the cable field, their initial use will be as constituents of blends of polyethylene designed to meet specific requirements. It has been suggested, however, that the low water-vapour permeability of high density polyethylenes, coupled with their superior abrasion resistance, may make it possible to use these materials for underground telephone cable, thereby dispensing with metal sheathing.[16]

Rigidex polyethylene (density 0·96) is recommended for the insulation of small communication wire, where its excellent electrical properties, toughness, and high softening point are useful qualities. This material has a high resistance to conductor migration under compression or flexing stress and its use may thus reduce costs of communication line maintenance. It may be possible to use thinner coatings of this polyethylene than those now obtained with conventional material. The high resistance to oils and chemicals may be exploited in coating wire for use in corrosive conditions.

For electrical mouldings, such as bushings, coil formers, aerial mounting insulators, radar and TV dipoles, the extra rigidity and strength of the high density polyethylenes should prove of value and may lead to a general reappraisal of design considerations.

Expanded polyethylenes are of great interest at present for high-frequency work, notably TV aerial downleads. Generally speaking, they offer a low power factor and a lower dielectric constant, coupled with lightness, a reduction in size, and economy in material. Two problems exist. Firstly, how to achieve a uniform cell structure, which is small and non-interconnecting; this is being solved by careful attention to the control of extrusion conditions and to achieving a completely homogeneous mixture of the polyethylene and the expanding agent. The second difficulty arises out of the residue

left by the expanding agent after it has decomposed. If this residue is polar, it raises the power factor of the expanded polyethylene. This problem is being approached in two ways: by developing expanding agents which leave low-loss residues; and by searching for a means of eliminating ionisable residues. There is every indication that these difficulties are on the point of being solved.

When expanded, high density polyethylenes offer mechanical properties which are considerably superior to the low density materials, including excellent crush resistance. One authority has offered the view[1] that cellular polyethylene may compete with orthodox types of insulation where polyethylene was previously at a disadvantage economically, saying that ". . . with this material it is possible to equal or even surpass the electrical characteristics of paper cable of equivalent size. . . ."

One criticism made of high density polyethylenes produced by the low-pressure process is that they contain catalyst residues which adversely affect the electrical properties of the polymer. This criticism was presumably based on the evaluation of pilot plant production which yielded relatively impure materials. It is not true of Rigidex, for example, which has the same low power factor (0·0001) as conventional polyethylenes.

Altogether, developments in polyethylene for electrical purposes are very fluid at present and it is difficult to say with certainty how the high density materials will fit into the general pattern.

Irradiated Polyethylene

Available in pilot plant quantities in Great Britain, irradiated polyethylene is said to offer several advantages over the conventional material.[18] It promises well as an extruded covering for insulating wire and in film form for sleevings and tape. Examples of its use include transformer insulation, wrapping of generator coils and as a condenser dielectric. A virtue of the material is that it can be pre-stressed and shrunk on to a component or assembly by heating it above its transition point. An equipment wire incorporating an irradiated modified polyethylene dielectric for use at temperatures of 100 deg C, with a short-term operating temperature of 150 deg C, has been introduced by Mersey Cable Works, Ltd.[2] Irradiated polyethylene cable of this type can be soldered right down to the insulation, and heat generated by momentary overloads, which would damage conventional polyethylene, does not melt the material but converts it to a rubbery substance which retains some useful strength up to 450 deg C.

Polyester/glass coil supports used on the main formers and torus of ZETA, at Harwell. Made by Permali, Ltd., on behalf of Metropolitan-Vickers who built the ZETA equipment. Resin used was supplied by British Resin Products, Ltd.

Adhesive for Polyethylene

It has recently been reported[3] that Bell Telephone Laboratories of New York have developed an adhesive for polyethylene, based on partly hydrogenated polybutadiene. It can be used for bonding polyethylene to brass and to various synthetic and natural rubbers. Among its uses is the joining of polyethylene to brass in submarine telecommunication cable repeaters, where its application enables a complex bonding technique to be considerably simplified. Some work by the Electrical Research Association on the use of hydrogenated polybutadienes as bonding agents for plastics and metals has recently been published.[17]

Polypropylene

Of interest for electrical purposes are the polypropylenes now available in development quantities in this country. They have a high melting range, reported to be between 325 and 340 deg F, good dimensional stability and greater tensile strength and better rigidity than high density polyethylenes. They possess excellent electrical properties and are highly resistant to cracking. Because their density is in the range 0·90-0·91, the polypropylenes provide more product per unit weight than the other polyolefines. They have a high fluidity and are no more difficult to process than the polyethylenes. However, they do not possess good resistance to ageing and their low-temperature properties are poor.

P.T.F.E.

Polytetrafluorethylene is rapidly becoming of great importance to the electrical industry. Its unique electrical properties and relatively high working temperature have been appreciated for some time, but only in the last few years has sufficient progress been made in the processing of the material for it to be used on a sizeable scale.

One of the most important developments has been the perfection of p.t.f.e. paste for extrusion. This version of the polymer is said to give a more flexible covering than granular p.t.f.e., with twice the tensile strength and elongation. The covering has a flexural fatigue life many thousands of times greater than coverings produced from granular material, and has a high resistance to cracking. Wires covered with p.t.f.e. can be used continuously at temperatures above 110 deg C and they will withstand repeated soldering without damage.

Calendered p.t.f.e. tape is now being made in Great Britain.[4] This form of the material has the advantage over veneered taper or cast p.t.f.e. film that it is manufactured in the unsintered state and can thus be sintered after the tape is applied. Commercially available tape is soft and pliable and lends itself to wrapping or shaping over irregular configurations. Overlappings applied under tension or slight pressure will fuse during sintering to form a homogeneous mass, which is of great value in insulation work. For wire covering, however, Bowley has sounded a warning note,[5] preferring p.t.f.e. paste coatings, which are less liable to breakdown under

immersion type electrical tests, due to inadequate fusing at the overlap.

With this reservation, for motors and generators operating at high temperatures, p.t.f.e. tape is an improvement on materials hitherto available, and its use may well enable the design of equipment of this type to be made more compact than previously, while the inertness of the material gives it distinct advantages for motors operating under corrosive conditions. The availability of p.t.f.e. tape may also stimulate an increase in the taped construction of distribution and other types of transformer equipment.

Polycarbonates

The polycarbonates are a new group of thermoplastic polymers which have been developed by the General Electric Co. of America and Farbenfabriken Bayer A.G. in Germany. Although not yet commercially available in this country they are, nevertheless, of considerable interest on account of their unusual properties, of which perhaps the most important is their very high impact strength. According to one source,[6] the General Electric material (known as Lexan) has an impact strength of between 12 and 16 ft lb/in, notched Izod, compared with about 3 ft lb/in for nylon; another report[7] claims that it is stronger than aluminium. Lexan has low water absorption and the relatively high heat distortion point of about 140 deg C; it thus has good dimensional stability.

Mouldings produced from Lexan can withstand continuous heat up to their softening point, without distortion, and they have "outstanding thermal and oxidative stability." The material is said to have good weathering characteristics.

The electrical properties are extremely useful, as can be seen from Table 2, and they are maintained through a wide range of atmospheric conditions.

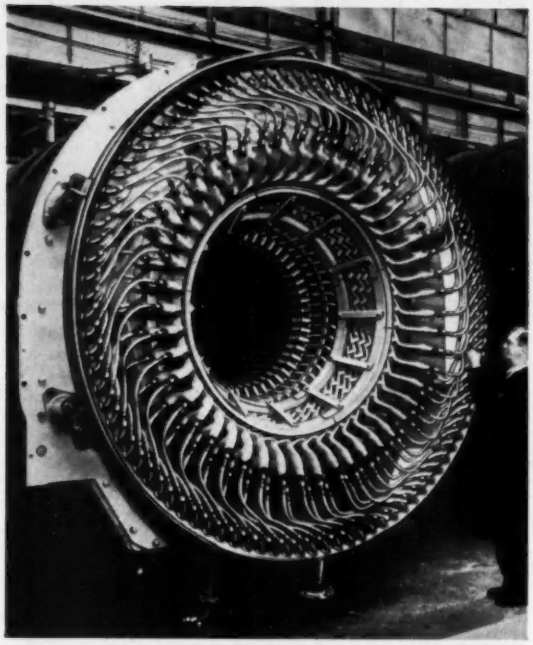
Table 2.—Properties of Lexan

Property	ASTM Test	Value
Power factor at 60 c/s (23 deg C) ...	D150	0·0009
Power factor at 10^6 c/s	D150	0·010
Volume resistivity (ohm/cm) ...	—	$2·1 \times 10^{16}$
Arc resistance (seconds)	D495	10–11
Dielectric strength (V/mil) (short time, ¼in)	D149	400
Dielectric constant at 60 c/s... ...	D150	3·17
Dielectric constant at 10^6 c/s ...	D150	2·95

Lexan can be moulded satisfactorily on conventional equipment, using heated moulds; full details have been given recently in the plastics Press. Uses for the polycarbonate resins include coil formers, battery cases and components, the varnish coating of conductors and panels for electronic equipment. There seems little doubt that the polycarbonates will prove of considerable value in many applications, both as injection moulding and film-forming materials.

Nylon (Polyamides)

Although polyamides have first-rate mechanical properties, those produced in Great Britain have not made much progress in the electrical field due to their comparatively high moisture absorption, which has an adverse effect on their electrical properties. A new range of nylon materials, made in France and now sold in this country by Whiffen & Sons, Ltd., under the trade name of Ralsin, promises to extend the scope of nylon in electrical applications. Ralsin has a longer molecular chain than other nylon materials and is less polar; hence it is less affected by moisture and chemicals. Ralsin is thus



New water-cooled stator, made by Metropolitan-Vickers, showing the hose assemblies in position. These are made from "Fluon" p.t.f.e. C.D.1

only slightly influenced by changes in relative humidity and it remains a good insulator in a saturated atmosphere or even when immersed in water. After four days at 80 per cent relative humidity, the resistivity is 160 megohms/km, compared with 0·1 megohm/km for nylon 6, and nylon 6-6. Mouldings can be used continuously at temperatures up to 100 deg C and for short periods up to 140 deg C.

The makers claim that the material can be used as the primary insulator in equipment working at low and medium voltages and frequencies, such as windings in motors and solenoids. It is used in coating wire for aviation equipment (0·2 mm thickness) and for aerial branch lines (0·1 mm thickness). Flexible grades of Ralsin are used as a mechanical protection over polyethylene for field telegraph cables, high-voltage or high-frequency wires or cables, over p.v.c. for telephone wiring and over glass cloth windings for use on aircraft. One grade is employed for insulation of wires and cables in refrigeration equipment, where it will withstand temperatures down to −70 deg C. Electrical components coated or dipped in Ralsin have excellent chemical resistance, which is of value in mines, on board ship and in the tropics. Some properties are given in Table 3.

Table 3.—Properties of Ralsin Polyamide

Density	1·04
Melting point (deg C) ...	186
Volume resistivity (ohm-cm) (20 deg C, 1mm thick) ...	6×10^{13}
Dielectric strength (kV/mm)...	25
Power factor at 1 kV and 1 kc/s	0·03
Tensile strength (p.s.i.) ...	7,400–8,500

Provided that the material is properly formulated, it is not affected by light or by weathering, and a special grade of black Ralsin has been used successfully

in North Africa for aerial branch cables, for several years, without ageing. A fungicidal grade resists the action of tropical moulds and fungi, and after seven weeks' exposure under standard tropical test conditions the electrical characteristics of this grade remained unimpaired.

Polyurethane

This material is being taken up by electronic manufacturers for wire enamels, where it offers some important advantages. At soldering temperature, for example, it disintegrates without leaving a carbon residue; thus no stripping or fluxing is necessary and both soldering and assembly can be put on to a fully automatic basis. Polyurethane foam filled with carbon black or metal dispersions is employed in instruments to absorb stray microwave emission.

Polyurethane-coated polyester fabrics have excellent electrical properties and very good resistance to tropical ageing and to hot oils. They retain their strength and flexibility even after 300 hours at 150 deg C, and they do not accelerate corrosion of electrical terminals.

Acrylonitrile Copolymers

A series of acrylonitrile-acrylate copolymers has been investigated for the purpose of wire coating, and some of the copolymers show useful properties.[8] For example, a 50 per cent by weight copolymer of acrylonitrile with decyl acrylate has good strength characteristics at elevated temperatures, and resistance to moisture. The volume resistivity after seven days in water at room temperature was $2{\cdot}5\times10^{14}$ compared with $3{\cdot}1\times10^{10}$ for nylon 6-6; before the test the figures were $7{\cdot}6\times10^{14}$ and $4{\cdot}4\times10^{13}$ respectively.

Polyesters

Polyester resins are becoming firmly established for casting, potting and encapsulation. With a wide range of resins and fillers available for different purposes, interest is now concentrating on solving problems which occur during the mass production of cast units: the need for strict quality control has been discussed, with special reference to high-voltage applications.[9] Abroad, automatic equipment has been designed for handling multi-component resin mixtures on a production basis.[10] This is said to provide uniform quality of cast units (and a wide range of other products, including foams, laminates, adhesives and thermosetting extrusions) and to offer many other advantages. The equipment described was being used for electronic casting and sealing in "critical dielectric applications for miniature and sub-miniature circuits."

Polyester dough moulding compounds have recently been introduced in this country on a commercial scale. They are putty-like materials consisting of an unsaturated polyester resin mixed with styrene, containing chopped glass fibre and a mineral filler. When heated the resin and styrene copolymerise to form a hard, cross-linked end-product which has excellent electrical properties, high impact strength, and good dimensional stability. A feature of mouldings produced from these compounds is their heat stability: one material is said to retain a high level of mechanical strength after prolonged exposure to temperatures as high as 200 deg C.

Dough moulding compounds flow easily and are relatively quick curing; because no volatiles are liberated, as is the case with phenolics and ureas, the compounds do not require "breathing" in the mould and, since no water is trapped within the moulded material, there is virtually no shrinkage on ageing.

Certain precautions have to be observed when handling dough moulding compounds. For example, because of their slight tack, care is necessary to avoid contamination. Also, wherever possible, the compounds should be introduced as a single charge, to avoid the formation of weld lines which might cause weakness in the final moulding. However, the unusual properties of dough moulding compounds will undoubtedly offset these relatively minor handling difficulties. Complicated electrical components can be produced to accurate tolerances, and the electrical qualities and arc resistance are such that the materials can be used for high quality switchgear. Other applications include motor housings, fans, stand-off insulators, coil forms, brush holder bases and circuit-breaker bases. Development work is in progress on extruding polyester/glass doughs and it is understood that extruded sections possess very good electrical characteristics.

Polyester film is finding a number of important uses in the electrical industry. It is transparent, flexible, very strong, and abrasion resistant, and retains its mechanical properties over a wide range of temperatures. The volume resistivity and dielectric strength are both very good and because of its low water absorption these properties are maintained at high humidities. The film is available in extremely thin gauges, e.g. 0·00025in, and this makes it particularly useful for components such as capacitors. Smaller components can be made for a given voltage and in d.c. capacitors the need for impregnation is largely avoided. Metallised polyester film is available, which further assists miniaturisation.

Polyester film is employed as a base for magnetic recording tape, where its great strength means that a very thin base can be used, thus extending the playing time of a given sized reel by as much as 50 per cent. An interesting development has been the use of polyester tape for making small coils, which are produced by alternating strips of metal foil with strips of tape. The resultant unit can be utilised as a filter, or transformer.

In larger assemblies its use frequently permits appreciable savings in volume to be achieved. For example, it is employed for slot liners and phase insulation for electric motors, either on its own in the thicker gauges, or laminated to other materials such as paper or mica, in the thinner gauges. The high electric strength of polyester film enables motors to be built which have a higher rating for a given size, or a smaller and cheaper motor for a given rating. Because of its insensitivity to moisture it can be used for the insulation of motors exposed to humid atmospheres and in some cases it is possible to dispense with impregnation.

Similarly, polyester film offers space saving advantages as inter-layer and inter-coil insulation in chokes, transformers, high-voltage TV coils, etc., and as a wrapping and taping material for power cable, and for telephone distribution and high-frequency cable. Pressure sensitive tapes having good high-temperature characteristics are now being produced from polyester film coated with silicone adhesives.

Epoxide Resins

Ultimately, the epoxides are going to prove of very great importance to the electrical industry. They combine excellent electrical properties with toughness, good non-ageing qualities, resistance to water and chemicals, low shrinkage on curing and outstanding adhesion to metals, porcelain, mica and other materials used in electrical equipment. To meet difficult specifications, a great many modified resins are now available in this country, including epoxide-polysulphide, epoxide-polybutadiene, and epoxide-polyamide systems, as well as low density

Electric motor stator fitted with Melinex/Elephantide slot liners

expanded epoxide foams, and some interesting accounts of the growing uses in Great Britain for epoxide resins, both in the electronic field and in heavy electrical engineering, have recently been given in the technical Press.[13,20] However, Continental and American practice is in some respects ahead of British development, due to the fact that the materials were available in quantity earlier than in this country. A paper given recently in London has referred to some impressive achievements by epoxide resins on the Continent.[10] One of these is an impulse generator unit with its parts contained in an insulating cylinder of epoxide resin comprising several tubular sections placed on top of one another, each for 250 kV peak voltage. The sections have diameters of up to 6½ft and were made by centrifugal casting, using a hot-cure formulation and quartz flour filler. The number of sections can be increased at a later stage, if required. The unit can be used out of doors and the resistances, being embedded in the epoxide resin, can be changed or exchanged, if required.

Another development has been the use of epoxide resins for casting stand-off insulators which have several advantages, except cost, over porcelain insulators.[11] The dimensions of epoxide insulators can be held to much closer tolerance, 0·1-0·2 per cent compared with 5 per cent in the case of porcelain. Their mechanical strength is greater and they have superior impact resistance. Fittings can be incorporated in the insulator during casting, which reduces the height of the unit, saves additional bonding operations and reduces the stress between the various materials with different coefficients of expansion. For a given rated voltage, the epoxide insulators are smaller than their porcelain counterparts.

One notable use of epoxides reported from across the Atlantic[12] is for encapsulating 150 large 100 h.p. totally enclosed motors, to protect the windings against moisture and acid dust, which destroyed phenolic varnish insulation in 3-4 months, leading to immediate burning out. During a three-year period not a single failure occurred. Another development has been the use of quick curing epoxides for potted splices in power cable.[14] The splicing is carried out in p.v.c. or butyrate moulds which are snapped together round the cable; straight line and Y-connections are catered for. The resin/hardener mix is poured into the moulds through polyethylene spouts. When cured the resin is said to have a dielectric strength of 800 V/mil and cut-away sections of these splices show that the resin fills all voids and works its way between individual strands of wire, thus blocking any moisture travelling along the conductor or along the insulation.

An epoxide adhesive developed in America, said to be capable of replacing solder, can be used as a conductive surface coating and has a bond strength of 2,000 p.s.i.[15]

Epoxide moulding compounds have appeared in this country within the last year or so. So far no industrial uses have been reported, but the advantages claimed for Continental materials include good flow characteristics, relatively rapid curing cycles (about 4 min), good heat resistance and high insulation strength. In addition, large metal inserts can be incorporated during moulding, without cracking.

The Future

In his recent Kelvin Lecture Dr. H. W. Melville urged that electrical engineers should pay heed to chemists, because they could now make materials to order. Theoretically, the development of isotactic polymers enables molecular structures to be produced which will give end-products of predetermined physical properties, and much work is being done in the polyolefine field to realise this aim in practice. There are indications that advances in stereospecific polymers will soon accelerate in many other directions as well. This survey has dealt with some of the already considerable number of plastics now available for electrical purposes. During the next few years this number should greatly increase as the electrical engineer comes to realise that the plastics industry can now produce materials designed for a specific purpose.

REFERENCES

1. MILDNER, R. C., and SLAUGHTER, R. J. "Polythene." Iliffe & Sons, p. 448.
2. "Irradiated Modified Polyethylene Dielectric." *Rubber and Plastics Age*. November, 1957, p. 959.
3. "Adhesive Bonding of Polythene." *British Plastics*. November, 1957, p. 490.
4. "Calendered P.T.F.E. Tape." *Plastics*. January, 1958, p. 31.
5. BOWLEY, G. W. "Recent Developments in Fluorine Polymers." *Plastics Progress*, 1957. Iliffe & Sons, p. 303.
6. "Polycarbonates." *British Plastics*. March, 1958, p. 112.
7. *Modern Plastics*. January, 1958, p. 154.
8. ROSENBERG, J., and GREENBERG, H. L. "Acrylonitrile-Acrylate Copolymers for Wire Insulation." *Modern Plastics*. December, 1957, p. 173.
9. FLETCHER, K. A. "Casting Resin Applications in Electronic Equipment." *British Plastics*. March, 1957, p. 90.
10. MEYERHANS, K. "Some New Applications of Epoxide Resins on the Continent." *Transactions and Journal of the Plastics Institute*. October, 1957, p. 267.
11. Aero Research Technical Notes. Bulletin No. 167. November, 1956, p. 2.
12. LEE, H., and NEVILLE, K. "Epoxy Resins." McGraw Hill, p. 192.
13. GOODCHILD, A. G. "Epoxide Resins in the Electronics Industry." *British Communications and Electronics*. June, 1956.
14. "Potted Splices in Electrical Power Cables." *Modern Plastics*. February, 1957, p. 90.
15. *Product Engineering*. 10th March, 1958, p. 49.
16. JAVITZ, A. E. "Developments in Polyethylene Insulation." *Electrical Manufacturing*. March, 1957, p. 116.
17. WRIGHT, D., and PARKMAN, N. "Hydrogenated Polybutadienes as Bonding Agents for Plastics and Metals." *British Plastics*. June, 1958, p. 255.
18. CHARLESBY, A., and BAIN, T. "Irradiated Polythene Film." *British Plastics*. April, 1957, p. 146.
19. SCHNEIDER, M. "Automatic Production Equipment of Resin Mixes." *S.P.E. Journal*. September, 1954, p. 22.
20. ELLIS, R. F. "Casting and Encapsulating Resins and Their Application to Transformer Production." *Electricity in Industry*. Foster Transformers, Ltd.

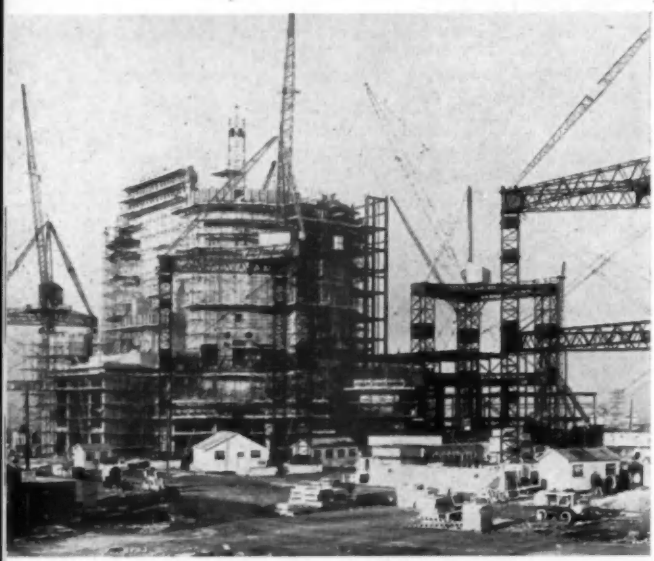
HUNTERSTON POWER S

REVIEW OF CONSTRUCTIONAL PROGRESS

THE steady growth of Scotland's first nuclear power station at Hunterston, on the Ayrshire coast, continues to be maintained. It is now about a quarter of the way through the total period allowed for constructing and commissioning the station. The first reactor building has reached an advanced stage and the supporting skirt for the reactor pressure vessel has been erected inside the concrete shield. Meanwhile, rapid progress is being made with civil engineering work on the second reactor, the turbine hall, and the extensive circulating-water system, and a start has been made on the construction of several ancillary buildings.

This 320 MW power station, which was described and illustrated in detail in the *Electrical Review* of 26th April, 1957, is being built for the South of Scotland Electricity Board by the General Electric Co., Ltd., in association with Simon-Carves, Ltd., the Motherwell Bridge & Engineering Co., Ltd., and Mowlem (Scotland), Ltd.

The reinforced concrete shield walls of the first reactor building have now reached a height of 120ft above the foundation raft. For constructional purposes, both the inner and outer walls were divided radially into eight sections; the concrete was placed in 5ft lifts, diametrically opposite sections being cast in turn. A single lift of this size on one section of the wall contains between 80 and 120 cu yd of concrete which can easily be placed in one shift. Gaps of about 6ft were left between adjacent sections to minimise shrinkage effects, and these were concreted at a later stage.



First reactor building; the shield walls have now risen about 120ft above the ground

The concrete has been cured by spraying the surface with "Ritecure," a material which forms a sealing membrane, as soon as the shutters have been stripped. The membrane begins to evaporate after about four weeks, leaving a generally good standard of finish.

One of the most difficult civil engineering operations has been the casting of the bottom biological shield. This shield, above which the reactor pressure vessel will be built, is circular and rests upon a rebate formed in a ring beam carried by eight massive supporting columns. It is 6ft 6in thick and its lower surface forms the roof of the chamber in which the charge/discharge machine will operate. The 101 standpipes through which the charge/discharge mechanism gains access to the interior of the pressure vessel must pass through the shield, and steel sleeves were cast in for this purpose.

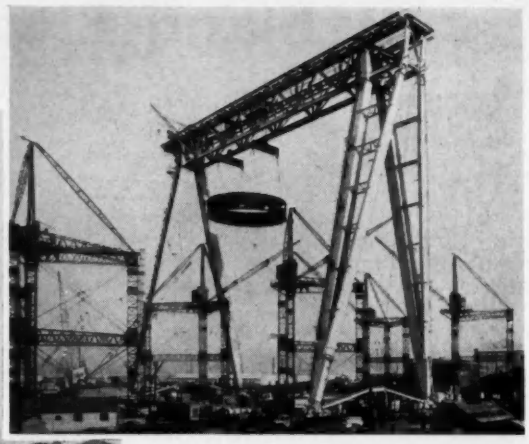
The bottom shield contains 397 cu yd of special heavy concrete, made with "Grandesburg" iron ore instead of ordinary aggregate, and is heavily reinforced. Before concreting began, the standpipe sleeves were accurately placed on the timber shutter by means of a cruciform jig at the bottom and by metal lugs welded to the surrounding reinforcement at the top. Placing the concrete into the complex structure formed by the sleeves and the reinforcement presented many problems, particularly as it had to be carried out in a time short enough to ensure homogeneity of the concrete and to maintain a minimum density of 210 lb/cu ft. Two "mock-ups" of a section of the shield were made and concreted to determine the best way of meeting these problems. Using the method proved by these tests, the shield was successfully cast in a continuous process taking 39 hours.

The top biological shield above the pressure vessel will be partially formed of, and supported by, massive concrete beams. These beams, the largest of which weighs 308 tons, have already been precast on the area between the two reactors and will later be lifted into position by the 300-ton Goliath crane. Much time and labour have also been saved by precasting slabs to form floors at various levels inside the "blimps" between the inner and outer shield walls.

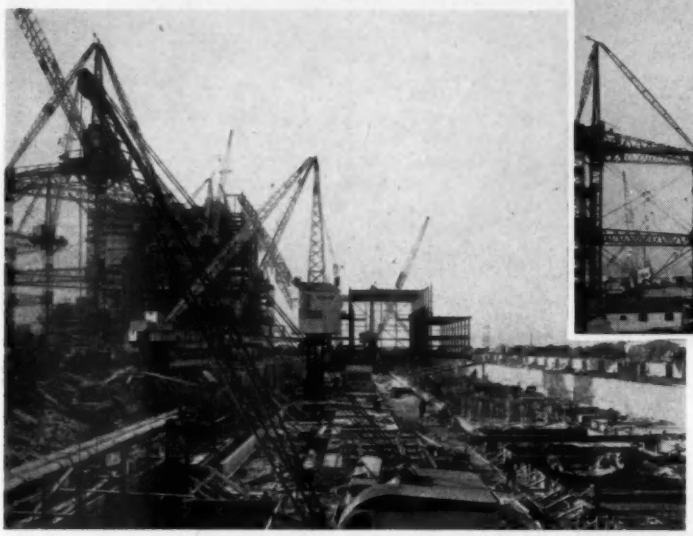
The fabrication of the sections of the 70ft diameter

Standpipe sleeves being placed in position before the casting of the bottom biological shield in the first reactor building

ER STATION



Supporting skirt for the first reactor pressure vessel being lifted into position by the 300-ton Goliath crane



Basement of turbine hall showing the structural steelwork in course of erection at the far end; on the left is the first reactor building

spherical steel pressure vessel for the first reactor is now reaching an advanced stage. The bottom crown of the vessel is almost completed and will soon be welded to the next or supporting course before being lifted into the reactor building by the Goliath crane. Meanwhile, fabrication of the subsequent courses of the vessel is in progress. The welding of all these components is being carried out under temperature-controlled conditions inside four 80ft diameter steel enclosures situated on the prefabrication area at one end of the site.

The cylindrical skirt on which the pressure vessel is to be supported has already been completed and was lifted into position on Christmas Eve. It was the first major lift by the Goliath crane, although it had already been carrying out routine operations for a number of weeks after the successful completion of its proving tests up to a capacity of 350 tons.

In the site workshop adjacent to the prefabrication area, the 80ft high by 20ft diameter cylindrical pressure shells for the steam-raising units are being fabricated. Most of this work is being carried out by machine-welding techniques using two Quasi-Arc Union-Melt machines, although manual welding is being employed on the main seams of the dished bottom heads and the conical top heads. The first of the 16 shells, eight for each reactor, will be off the production line this spring, and the others will follow at six-weekly intervals.

The foundation rock on the site of the second reactor was found to be rather sounder than that under the first reactor. The excavation, mass concreting and the placing of the foundation raft have now been completed and a start made on the reinforced concrete superstructure.

The basement of the turbine hall is now approaching completion and the erection of the structural steelwork has begun. The basement consists of mass-concrete piers carrying stanchion bases, and a reinforced concrete floor slab cast in two lifts. It is enclosed by a cantilever retaining wall which is replaced on the north side by the circulating-water intake and outlet ducts. These ducts have been cast in bays about 40ft long with rubber water stops at all construction joints, and the pipe connections to the condensers have been cast in during concreting. Erection of the building framework embodying about 2,400 tons of steel was started last November, using a 10-ton derrick running on rail bogies.

The station's full-load demand for circulating water will be 324,000 gal/min. Substantial progress is being made on the intake and outlet culverts to meet this requirement, and the construction of the pump house, about half a mile to the south of the main site, is proceeding according to schedule after the excavation of about 20,000 cu yd of rock.

The two 11ft diameter tunnels which will connect the intake headworks to the vertical shafts in front of the pump house forebay will be about 550ft long. The tunnels have now been driven some 300ft and are being lined with concrete, while the necessary arrangements have been made for possible compressed-air working beyond this point. All the special facilities required for this type of operation, including a medical decompression lock for the treatment of any cases of compressed-air sickness which may arise, have been provided near the shafts. Excavations for the two outfall land shafts are also continuing.

It has been decided to use caissons in preference to cofferdams for the construction of the actual inlet and outfall headworks, largely because they are less liable to damage by heavy seas. The caissons are at present being built on the Clyde, and temporary working stagings are being constructed at the intake, 400ft offshore, and the outfall, 1,300ft offshore, in readiness for their installation. At the same time, piles have been driven to support a permanent jetty which will permit lorries to reach the intake headworks for cleaning and maintaining the coarse screens.

Below ground there has been laid a network of cable ducts and of service pipework covering storm water disposal, sewage disposal, fresh water supply and fire water supply. All these services are interconnected with the buildings.

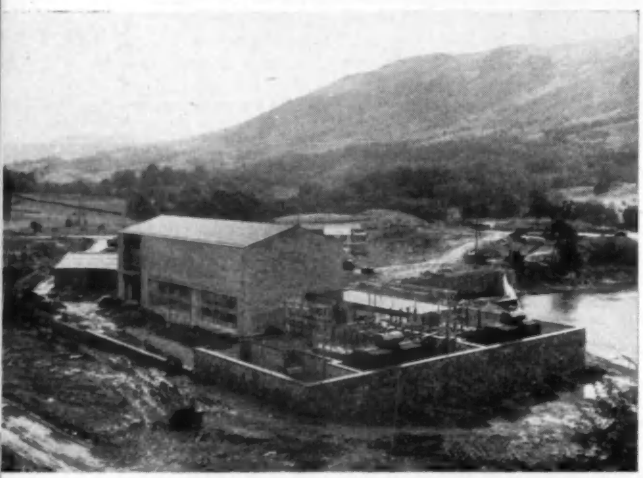
Highland Electricity Supply

North of Scotland Hydro-Electric Board's Annual Report for 1958

THE annual report and accounts* of the North of Scotland Hydro-Electric Board, which was published last week, states that in its first 15 years the Board completed the development of about a quarter of the estimated usable water power resources of the Highlands. As a result, electricity is now being supplied to more than 90 out of every 100 people in the Board's area.

A loss of £112,238 on operations in 1958 increased the deficiency on revenue account to £724,456 by the end of December. Considering what has been achieved in the short time since the Board was established and the fact that it has had to carry out its developments without Government grants of any kind, the Board regards the position as not unsatisfactory. Rainfall in the catchment areas in 1958 was 14 per cent below average and this involved considerably more expenditure on steam generation and on the purchase of electricity from the south. This is the second year in four that the annual rainfall has been well below average.

* H.M. Stationery Office, price 5s.



Lochay power station (above) and Lubreoch Dam (below) in the Killin section of the Breadalbane Scheme

Interest rates on long-term borrowing remained high—during 1958 the Board paid £256,000 more in interest than it would have paid if the rate had been the same as in 1957—and the slackening of industrial activity in 1958 reduced the expected increase in sales and the benefit from the tariff revisions of July, 1957.

The total capital expenditure during the year amounted to £15,398,133 and the aggregate capital expenditure to the end of the year was £192,301,000 sub-divided as shown in Table 1. The income from the sale of electricity to ordinary consumers was £9,663,240 and that from the sale of electricity to the South of Scotland Electricity Board was £3,034,946.

The present state of the programme of hydro-electric development is given in Table 2.

New Plant Commissioned

During the year hydro-electric plant with an installed capacity of 84,000 kW was brought into service. The second set at Glenmoriston provided 18,000 kW, the latest Breadalbane scheme station at Lochay 45,000 kW, and the first set in the Shin station at Inveran 12,000 kW. The balance was made up from Lubreoch, Dalchonzie and small compensation sets. The completion of the Glenmoriston scheme in September was marked by a public ceremony at which Sir Christopher Hinton performed the official opening. St. Fillans power station, which was described in the *Electrical Review* of 4th July, 1958, was also opened during the year at the completion of this section of the Breadalbane scheme.

No new diesel generating plant was commissioned. The erection of the peat-fired gas-turbine at Aultnabreac was completed by May and the set was connected to the grid system for the first time in June. Since that date running experience has been gradually built up, initially on oil fuel and later on milled peat.

The number of new consumers connected during the year was 9,997. This was a reduction on the number connected in previous years and was due not only to the effect of limited capital resources but also to the present-day high cost of supplying scattered consumers in the remote districts to which the mains are now being extended. The Board, however, will continue to press ahead with these extensions and with reinforcement of existing networks to the limit of the finance available.

TABLE I.—TOTAL CAPITAL EXPENDITURE

Hydro-Electric Schemes	£132,591,000
Steam and Diesel Power Stations	5,522,000
Transmission Lines	15,135,000
Distribution	37,545,000
Sundry	1,508,000
	£192,301,000

General view of the main dam and the lower reservoir of the Glen Shira project

The demand for electricity in the North of Scotland continues to rise and the number of kWh sold to consumers during the year was 1,349 million, or more than three times the 1948 figure. The maximum demand was 437,000 kW in January. This does not include the islands and areas with independent generation for which about

TABLE 2.—HYDRO-ELECTRIC SCHEMES

Schemes	Capacity, kW	Average Output (Million kWh)
Already in operation	813,066	2,293·15
At constructional stage	169,256	432·1
In course of promotion	448,000	527·0
Under Survey	224,000	765·0

22,500 kW should be added. The Board exported 463 million kWh to the South of Scotland Board and, in continuance of the interchange arrangements, bought 73·1 million kWh.

Power stations generated 2,043 million kWh of which 1,683 million was produced by water power. This was an increase of 130 million kWh on the total amount generated in 1957.

The Highland grid system now totals 1,630 circuit-miles with another 250 circuit-miles being built. The main transmission has so far not exceeded 132 kV, but during the year the Board decided to have a number of 275 kV lines to meet future requirements.

Two new 132 kV substations were commissioned at Fraserburgh and Persley. Various extensions were carried out and contracts were placed for equipment for Tealing 132 kV substation which is planned to become a terminal for a future 275 kV overhead line to the north.

In May, the Board approved proposals for 275 kV transmission lines and substations to the value of about £5,000,000. Negotiations for wayleaves have begun for a 275 kV double-circuit line between Beauly and Kintore and a similar one, but with only one circuit strung, between Kintore and Tealing. It is proposed to operate both these lines initially at 132 kV and to raise them to the full voltage of 275 kV in about 1964. A route is also being selected for a 275 kV line to connect the Loch Awe pumped storage scheme with the South of Scotland Board's 275 kV network at the Windyhill substation.

In the early months of the year, icing trouble was experienced on the 2,169ft high Lecht Pass on the border of the counties of Banff and Aberdeen. The automatic ice warning device operated successfully and, as a result, the control room at Aberdeen was able to arrange for heating currents to be applied to the iced-up conductors more promptly and more successfully than would otherwise have been the case.

Scheme Promotions

Final adjustments were made to the Awe Scheme and in its amended form it was referred to the Secretary of State for Scotland for confirmation. The Awe Scheme includes the first large-scale pumped storage development in Scotland at Cruachan with 400 MW of combined pumping and generating plant. It is proposed to utilise the difference in level (1,160ft) between Loch Awe and a reservoir to be formed higher up on the Cruachan Burn. It is hoped that this development will be available to meet the growing Scottish load by 1965-66, by which time the South of Scotland Board expects to have sufficient surplus high-merit generating plant capacity at nights and week-ends to provide the essential low-cost pumping units.

Preliminary investigations are being conducted into the design of the pumps and generating plant required for the Cruachan station and especially into the possibility of having reversible pump-turbines instead of separate machines. Investigations are also being made into the operating cycles and their effect on storage and the transmission arrangements.

After the Strathfarrar Scheme was confirmed in July, 1958, tenders were invited for the various works. During December, contracts were let for the dams and power stations at Aigas and Kilmorack and those for the works in Glen Strathfarrar will be placed early in 1959.

New Industries

The Board has not relaxed its efforts to bring new industries to the Highlands and amongst those which started during the year were the assembly of domestic cookers by the General Electric Co. at Inverness and the

TABLE 3.—FINANCIAL RESULTS

	1957	1958
	£	£
Revenue from sales of electricity, etc.	11,857,608	13,497,123
Revenue expenditure	4,471,698	4,928,618
Redemption fund appropriations and capital repayments	2,416,266	2,602,111
Interest and stock management expenses	4,969,285	6,078,632
Net surplus or deficiency	+359	−112,238

quarrying and crushing of magnesium limestone for agricultural purposes by William Lind & Son, at Ullapool. The Board is gratified to learn that the managements of both these projects are highly satisfied with the success of their ventures and with the quality of the local labour supply. As an alternative to new factories and with a view to assisting in the economy of the Highlands, an experiment in devolution in manufacture is being actively pursued by one large organisation which has practically all its present production in the south. This firm is exploring the possibilities of contracting out the manufacture of small components to existing establishments in the Board's area.

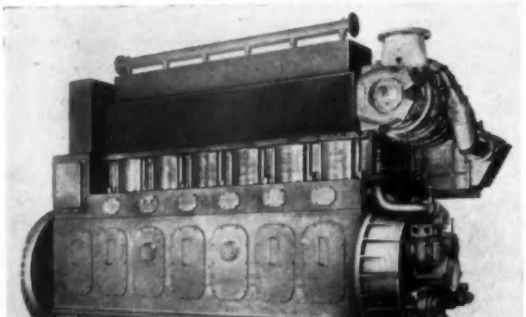
As a first step in dealing with the increasing problem of line charging current, the stability margin of hydro-electric machines at low loads has been examined at two generating stations. Useful information was obtained, including some about pole slipping. A d.c. universal load flow and fault calculator incorporating some new features has been designed and constructed by the Board's staff and will facilitate the accurate study of future transmission and generation arrangements.

The first battery-driven railcar in Britain went into service on the Aberdeen-Ballater branch line in the spring. This unit operates over a distance of 43 miles with battery-charging facilities at each end of the line. The purpose of the experiment is to improve tourist traffic in Deeside and to demonstrate that the use of battery railcars could make it possible to keep open rural branch lines which might otherwise be closed down. Up to 7th September the increase of passenger traffic as compared with the same period of the previous year was 96 per cent.

The document also contains the report of the Electricity Consultative Council for the North of Scotland District.

Medium Speed Diesel Engines

THE four ranges of medium speed engines introduced by Ruston & Hornsby, Ltd., Lincoln, before the last war were widely used for generating units at military establishments.



A type "AT" diesel engine

After the war these ranges were extended to cover requirements from 100 h.p. to 2,410 h.p., being used in overseas power stations and marine and industrial installations. A new series "AT" range of engines pressure charged by an exhaust turbo-blower and having power outputs from 705 to 1,645 b.h.p., has now been announced. Of compact design, resulting in minimum machinery space and foundation dimensions, the engines have a low fuel consumption over a wide range of loads. A solid and rigid engine structure has been developed and the crankshaft, designed to reduce bearing pressures to the minimum, has identical coupling flanges on each end, permitting full power to be taken from either end of the engine. The wide speed range—down to 360 r.p.m.—permits operation at 375, 428 or 500 r.p.m. when driving 50 c/s alternators and 360, 400, 450 or 514 r.p.m. for 60 c/s alternators.

During the design work a large number of calculations were carried out on an electronic computer. The operating cycle has been based upon the results of no fewer than 6,348 cycle calculations. During the electronic computation the effects of seven independent variables were studied, including maximum cylinder pressure, engine expansion ratio and boost pressure ratio, and in each calculation the specific fuel consumption, b.m.e.p., exhaust temperature and scavenge pressure drop were determined and the results plotted on three-dimensional graphs. A series of graphs were obtained from these which indicate the performance improvement obtainable by changing various factors.

Aerial Feeder Cables and Connectors

EFFICIENT aerial feeder cables and connectors are essential for high-quality reception of television and v.h.f. sound broadcasting. Two new British Standards covering these items have now been published. The first, B.S. 3040: 1958, "Radio-Frequency Cables for Use with Domestic Television and V.H.F. Broadcast Receiving Aerials," is a 14-page publication specifying dimensional and performance requirements, together with methods of test. The construction, dimensions and electrical characteristics are specified of radio-frequency coaxial cables having a nominal impedance of 75 ohms and nominal diameters over dielectric of 0·128in and 0·200in, and radio-frequency balanced twin cables having a nominal impedance of 75 ohms and a nominal major dimension of 0·160in.

Connectors for use with these cables are specified in B.S. 3041, "Television and V.H.F. Broadcast Receiving Aerial Feeder Connectors." This six-page publication deals with two types of feeder connector, each suitable for use with the forms of aerial feeder cable specified in B.S. 3040. Two versions of the socket of the connector for use with coaxial cables having a characteristic impedance of between 50 and 100 ohms, intended for use at frequencies up to, and including, Band III, are specified. One type is intended for attachment direct to apparatus and the other for attachment to a length of coaxial cable. The second type of connector is a polarised two-pin device suitable for use with either coaxial cable or balanced twin feeders at frequencies up to, and including, Band II. The standard specifies requirements for contact resistance but not for contact finishes.

Copies of these standards may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1., B.S. 3040 price 4s 6d and B.S. 3041 price 4s.

NEW TUBE STATION

A NEW Underground station at Notting Hill Gate, serving the Central and Circle Lines, was brought into use on 1st March. Built at a cost of £1,000,000, this sub-surface station links the two lines by a joint ticket hall beneath the road and gives direct interchange facilities by a subway at a lower level. Previously, passengers changing from one line to the other had to cross the main road.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Power has appointed **Mr. N. F. Marsh,** M.A., M.I.E.E., to be chairman of the East Midlands Electricity Board in succession to **Mr. J. Mould,** O.B.E., A.M.I.E.E., who retires on 30th April. Mr. Marsh is to be succeeded as deputy chairman by **Mr. A. H. Kenyon,** M.I.E.E., sub-area liaison officer, North Eastern Electricity Board. The Minister has also appointed **Mr. J. A. MacKerrell,** F.S.A.A., to undertake the duties of Board membership while continuing to serve as a full-time officer of the East Midlands Board and has reappointed **Mr. FitzHerbert Wright** as a part-time member of the Board.

Mr. W. H. McFadzean, who has been industrial leader and vice-chairman of the Advisory Council on Middle East Trade since it was set up by the President of the Board of Trade in February last year, has retired temporarily from this post, at his own request, consequent on his becoming president-elect of the Federation of British Industries, and during his term of office with the F.B.I., **Mr. G. H. Nelson,** managing director of the English Electric Co., Ltd., has agreed to take over as industrial leader and vice-chairman of the Council. Mr. Nelson is at present in Karachi and on 6th March will fly from there to the Middle East. He is returning to London on 17th March.

Dr. H. H. Ballin, director and technical sales manager of Atlas Lighting, Ltd., left London for the United States by B.O.A.C. Comet last week. During his visit he will be attending the National Lighting Exhibition in New York and will be spending some time with Sylvania Electric Products, Inc. He will also visit Chicago, Cleveland and Washington and will return to England in mid-March.

Mr. L. Harvey, M.I.E.E., manager of the Stone and Market Drayton District of the Midlands Electricity Board, has been appointed manager of the Board's Solihull District, following the recent death of Mr. C. T. Dunn.

Mr. Harvey began his career in the electricity supply industry in 1929 as a technical trainee with the Stoke-on-Trent Electricity Department and became assistant mains engineer in 1933. In 1942 he joined the Northampton Electric Light & Power Co. as mains assistant. From 1943 to 1945 he served with the Air Ministry Works Directorate on the construction and maintenance of electrical and mechanical installations on airfields in Norfolk. He returned to the staff of Stoke Electricity Department in 1945 as district engineer in the Stoke South East District, continuing in a similar post after the formation of the Midlands Electricity Board in 1948. In 1949 he was appointed manager of the Board's Stone District, which was enlarged by the incorporation of the Market Drayton District in 1955.

Mr. G. H. Armstrong, A.M.I.Mech.E., has been appointed chief production engineer for the Southern Works of the Crompton Parkinson group of companies and **Mr. G. Cubitt-Smith,** A.M.I.Prod.E., Grad.I.Mech.E., succeeds him as production engineer at Crompton Parkinson (Chelmsford), Ltd.

Mr. Armstrong was educated at Archbishop Tenison's School and served an apprenticeship with E.M.I., Ltd., and subsequently became production engineer of the Commercial Division of E.M.I. In 1948 he joined Crompton Parkinson, Ltd., and was

Mr. G. H. Armstrong

Mr. G. Cubitt-Smith

eventually appointed chief production engineer at the Chelmsford Works.

Mr. Cubitt-Smith gained the diploma of Loughborough College (mechanical) with honours. He served his apprenticeship with the English Electric Co., Ltd., and was for three years technical assistant to the welding works manager at Stafford. He joined Crompton Parkinson, Ltd., in 1949 and he was appointed a management trainee in 1953. Both Mr. Armstrong and Mr. Cubitt-Smith have served on the junior board of Crompton Parkinson.

Mr. D. G. W. Acworth, export director of the General Electric Co., Ltd., left London for the Middle East on Friday last. He will be away about a month and will be visiting Lebanon, Kuwait, Iran, Jordan and Persia.

Mr. J. Symes (South Eastern Electricity Board) and **Mr. F. Webster** (Yorkshire Electricity Board), who were respectively the best candidates from the electricity supply industry in last year's intermediate and final examinations of the Institute of Municipal Treasurers and Accountants (Inc.), have been awarded the first of the annual prizes provided by the £250 fund which was set up in 1957 by the Institute out of donations from the former Central Electricity Authority and the South of Scotland Electricity Board.

Mr. T. E. Dellow, of J. L. Miller & Co., has been appointed chairman of the Tyne and Wear Branch of the Electrical Industries Benevolent Association in succession to Mr. A. J. Crawford. **Mr. T. M. Ayres** has been appointed deputy chairman.

Mr. C. B. Evans has been appointed to the board of Midland Silicones, Ltd. He joined the company in 1955 as works manager of the plant at Barry in South Wales. Mr. Evans has spent all his working life in the chemical industry.

Mr. B. T. Dyett, F.C.I.S., A.I.A.C., financial director of R. B. Pullin & Co., Ltd., and associate companies of the group, was recently presented with a gold watch to mark the completion of twenty-one years' service with the company, by Mr. P. J. Ellis, O.B.E., managing director of R. B. Pullin & Co.

Thorn Electrical Industries, Ltd., announces that **Mr. V. Coffee** has been appointed a director of Tricity Cookers, Ltd. Mr. Coffee joined Thorn Electrical Industries in 1957 as domestic equipment divisional sales manager and later was appointed divisional manager. Before joining Thorn's he was assistant sales manager of the Domestic Appliance Division of the English Electric Co. He began his career with the Northmet Power Co. in 1935 and served as a captain in the Royal Artillery during the last war.

The reunion of employees of the former **Edmundsons Group** of companies will be held on 24th April at the Criterion Restaurant, Piccadilly Circus, London, W.1, when the chair will be taken by Mr. A. Hamilton Young, deputy chairman of Edmundsons Electric Co., Ltd. Those interested should communicate with Mr. F. T. Scribens, the Electricity Council, Room 421, Winsley Street, London, W.1.

The annual luncheon of the Liverpool Centre of the **Illuminating Engineering Society** was held on 2nd March at the Exchange Hotel, Liverpool, when Sir Josiah Eccles (deputy chairman, Electricity Council) outlined the developments, present and prospective, of the generating side of the electricity supply industry. The Lord Mayor of Liverpool (Ald. H. Livermore) congratulated the I.E.S. on having chosen a Liverpool man, Mr. C. C. Smith (city lighting engineer), as

its president in this the golden jubilee year of the Society. Mr. T. Jones (chairman of the Liverpool Centre) presided.

Mr. H. O. Jordan has been appointed to the boards of Strand Electric Holdings, Ltd., and associate companies to fill the vacancy caused by the resignation of **Mr. H. M. Cotterill.** During the forty years that Mr. Jordan has been with Strand Electric he has always been connected with the manufacturing side. He was appointed works engineer in 1936 and works manager in 1942. He will direct the company's two factories at Vauxhall and Chiswick.

Mr. H. O. Jordan

The British Aluminium Co., Ltd., has announced the following staff changes at its rolling mills:—**Mr. J. A. Richmond** has been appointed deputy manager at Falkirk with effect from 1st July next and has been nominated to succeed Mr. Field as manager when the latter retires in January, 1960. **Mr. T. D. Rees** becomes deputy manager at Latchford from 1st May. Changes with effect from 1st March include **Mr. R. L. C. McDonald,** appointed as assistant manager at Warrington; **Mr. F. C. Foskett,** chief production superintendent at Milton; **Mr. N. MacDonald,** deputy chief production superintendent at Milton; and **Mr. D. Lowe,** superintendent of the experimental department at Milton.

Following the recent retirement from active duty of **Mr. J. Horridge** on medical grounds, the appointment of **Mr. J. F. Willsher** as general works manager of George Kent, Ltd., has been announced.

Mr. J. F. Willsher

Mr. Willsher joined the company in 1947 on his release from the Army with the rank of captain; in 1951 he was appointed production controller and a year later production manager. In 1955 he was appointed manager of the Instrument Division, a post he held until taking over his present position.

With reference to the report in our issue of 20th February regarding changes in the board of directors of Rhodes, Brydon & Youatt, Ltd., and its subsidiary company, Furnival & Co., Ltd., we are now informed that **Mr. H. Aston** has been elected to the board of Rhodes, Brydon & Youatt, in addition to his appointment (which we reported) to the board of Furnival & Co., Ltd. Mr. Aston is also chief engineer for both companies.

Mr. R. H. Woodall, construction engineer of the Merseyside and North Wales Electricity Board at Welshpool, has been appointed district engineer at Crewe. He is being succeeded by **Mr. E. Corfield,** construction engineer at Wrexham.

The annual dinner of the **I.E.E. Scottish Centre** will be held on 19th March at the George Hotel, Edinburgh. Applications for tickets (25s 6d each for members and 12s 6d each for graduates and students) should be made by 14th March to Mr. J. H. P. de Villiers, c/o Bruce Peebles & Co., Ltd., 19, Waterloo Street, Glasgow.

Mr. R. F. Hunt, M.A., F.R.Ae.S., A.F.C.A.I., a director of the Dowty Group, Ltd., has been elected deputy chairman of the company.

Mr. F. A. Field has been appointed industrial contracts manager of Black & Decker, Ltd. Mr. Field joined Bosch, Ltd., as sales promotion manager in 1933 and left that company in 1939 to join Black & Decker as district manager at Leeds. He was appointed United Kingdom sales manager in 1953 and in 1957 left the company to join the Eutectic Welding Alloy Co., Ltd., as managing director, which office he has recently relinquished.

Mr. F. A. Field

The North Western Branch of the **Electrical Trades' Commercial Travellers' Association** held its ladies' evening on 24th February at the Embassy Rooms, Washway Road, Sale. Mr. G. P. Humphry (branch chairman) welcomed the guests and Mr. W. J. Bird (national president) made a witty reply. Mr. W. Smith (hon. treasurer) proposed the toast to the ladies, and mentioned that the Branch had donated over £200 to charity since October last year. Mrs. G. P. Humphry replied on behalf of the ladies.

At the recent **Crompton Parkinson (Chelmsford), Ltd.,** foremen and senior staff dinner, Mr. R. R. Kenderdine, managing director, Crompton Parkinson, Ltd., made the annual awards for long service. Forty-five employees received presentations. Twenty-nine of the recipients have been with the company for forty years and the remainder for twenty-five years.

The annual general meeting of the **Birmingham Electrical Golfing Society** was held in Birmingham on 24th February. The president, Mr. W. Horrocks, stated that the Society had enjoyed an encouraging year. He thanked all officers for their support during his year of office. The following were elected officers and committee for 1959-60:—President, Mr. T. C. Browne; captain, Mr. P. M. King; general committee: Messrs. J. T. Aitken and H. Martin; hon. secretary and treasurer, Mr. F. C. Mealing.

OBITUARY

Mr. W. J. Picken, O.B.E., M.I.E.E., technical consultant to the English Electric Valve Co., Ltd., died on 24th February at the age of seventy-two.

Mr. Picken served his apprenticeship with Crompton & Co., Ltd., Chelmsford. In 1913 he joined Marconi's Wireless Telegraph Co., Ltd., and carried out work in connection with their transatlantic stations at Clifden, Ireland, and at New Brunswick, N.J., U.S.A. From 1914 to 1918 he was engaged with Captain H. J. Round of Marconi's on the direction finding and interception network which played a vital role in the anti-U-boat operations around our coasts. In 1919 he went to Canada in connection with experiments in transatlantic telephony. The same year saw his transfer to the research staff of the Marconi Co. and he was engaged on valve development work until 1928 when he was appointed valve controller. He became deputy engineer-in-chief in 1935 and later engineer-in-chief, a position with which he combined that of general manager from 1938 to 1940.

Mr. Picken visited Canada and America in 1941 on liaison work in connection with wartime production in the wireless field. Upon his return in 1943 he was seconded to the Department of Scientific Research and Experiment where he worked with Dr. J. H. E. Griffiths in the department responsible for the development of all valves for defence purposes, and he succeeded Dr. Griffiths as secretary of that department in 1946. Mr. Picken retired from the Admiralty in 1953 and then joined the English Electric Valve Co., Ltd., as technical consultant.

Mr. Picken was for many years a member of the Technical Committee of the British Valve Manufacturers' Association, and he was chairman of the Wireless Section (now Electronics and Communications Section) of the I.E.E. for 1940-41.

Sir Walker Shepherd, chairman of Turner & Newall, Ltd., died in Nova Scotia on 28th February, at the age of sixty-three. He joined the company as secretary in 1927, was appointed to the board in 1931 and became chairman in 1944.

Price Reduction

As from 1st March, Siemens Edison Swan, Ltd., have reduced the prices of their "Cambridge" range of cooker control units. The reductions have been made possible by an increased demand for the units which has led to greater output and decreased works costs.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

13 A Socket Outlets

I HAVE been greatly interested to read, over the past weeks, various correspondents' views on 13 A socket outlets. Some agree they are good and some say they are bad. My own experience over the last five years has been that a reasonable amount of force is necessary to push the plug in and a good finger grip and a good pull is needed to get it out. One in the front bedroom was such a good tight fit that with constant use of an electric fire it began to loosen the skirting board on the wall.

There are, of course, cheaper makes which are not as good as others. However, the ones I have fitted in my house are very satisfactory and I would add that so far I have not found it necessary either to replace or repair any socket or plug during the last five years.

Billinge, nr. Wigan. STANLEY JOHNSON.

MAY I, as a professional electrical engineer, be permitted to make some observations in connection with the recent correspondence concerning the ring main socket outlet.

The principle of the ring main system is excellent, for domestic and other premises; it permits a useful number of socket outlets to be installed for a reasonable outlay. The design of the plug and socket to the rating of 13 A is not, however, realistic. The responsibility for this to a degree must rest with the committee set up to study electrical requirements for post-war building and subsequently with the authorities of B.S. 1363 and B.S. 2814. A 3 kW fire with an illuminated log or coal effect requires virtually 13 A. No self-respecting engineer would normally design a system for 100 per cent operation and by the same token the ring main socket outlet should be designed for continuous operation at 15 A.

My own residence was re-wired in 1955 and I took the opportunity at that time of having the ring main system installed. I have several electrical space heaters and fires and using a 3 kW fire of the type previously referred to, my experience is that the plug and the socket outlet get unreasonably hot after full load operation for about half-an-hour. This is not due to bad manufacture since I personally specified the make of socket to be installed, but simply because the plug and socket are overloaded because of inadequate design specification.

B.S. 1363 and B.S. 2814 both cover the ring main socket outlet, but only the flush pattern. This specification should be rewritten to cover all socket and switch socket outlets intended for ring main operation and should call for a design rating of 17 A minimum with a fuse rating of 15 A. The phase and neutral socket tubes should be designed for contact along the full length and on all faces of the plug pins and not as at present on the top and bottom faces only.

Another complaint that I have often heard repeated by contractors is the lack of space allowed behind surface switch sockets and socket outlets, and after investigation I agree wholeheartedly with the contractors. The looping of two or three 7/·029 or 7/·036 twin and earth cables requires considerable skill by an electrician to prevent the earth conductor being forced into the phase or neutral lines when the socket is screwed back on the skirting board or mounting block. A ½in minimum should be allowed. Badly designed fittings and fixtures encourage bad workmanship and I should be pleased to hear the N.I.C.E.I.C.'s views on this matter. Before writing this letter I carefully examined several different makes of socket outlets. They varied from good, i.e. complying fully with the relevant B.S.'s, down to downright shoddy. The latter I would hesitate to load to 2 kW.

Most new towns are being created as smokeless zones and therefore electric heating in various forms must become more popular. I consider it imperative that a re-appraisal of the design of the ring main socket outlet should be made by the authorities concerned to prevent the installation of further large numbers of sockets which may fail to give the 100 per cent service that the user is entitled to expect.

Kenton, Middx. D. BARNETT SALTER.

A Wholesaler's Plea

OWING to the forthcoming Budget, a number of manufacturers are postponing printing new price lists, and I therefore think this a good opportunity to appeal most strongly to all who will afterwards be producing new price lists, to print clearly on the cover or outer sheet, in big type, the date of issue.

The majority of manufacturers have very costly and beautiful price lists or catalogues but, for some reason unknown to myself, they either omit the date of issue entirely, or use the smallest possible type and find the most improbable position to insert this vital information. Another way of keeping this secret seems to be the use of hieroglyphics, which can be interpreted only by the manufacturer concerned.

It would also be of assistance to users if, when printing new price lists, a change could be made in the layout or colouring, to help quick distinction between the old and the new. I am sure my fellow wholesalers will join with me in giving thanks, should such things come to pass.

Birmingham, 5. WALTER LOWY,
Director,
Bevalite (Birmingham), Ltd.

A Question of Size

IN the article "Chinese Hydro-Electric Project" published in the *Electrical Review* dated 16th January (page 125) it is stated that the Chinese point out with pride that the capacity of the hydro-electric power station under construction at Sanmen Gorge, Shansien, Honan Province, will be 1,100 MW and that it will be greater than that of the Beauharnois station in Canada.

This statement needs the following qualification: the total capacity of 26 units installed after completion of the second stage development at Beauharnois was 1,065 MW. At present the third stage development at Beauharnois is under construction. After completion of the third stage, the total capacity of 36 units at Beauharnois will be 1,616 MW which will be greater than the capacity of the Chinese power station. There is a possibility of the addition, in the future, of one more unit at Beauharnois. The third stage development is scheduled for completion by the end of 1960.

Niagara Falls, Ont. S. E. GIESZCZYKIEWICZ, M.I.E.E.

New Books

Law and the Power Engineer. By Robert S. W. Pollard, L.A.M.T.P.I., J.P., and Arthur Palmer, A.M.I.E.E., M.Inst.F., M.P. Pp. 75. Electrical Power Engineers' Association, 102, St. George's Square, London, S.W.1. Price 4s 6d.

In an extended title above the introduction to this book its scope is more precisely defined as " Accidents, the Law and Electrical Power Engineers." Its main purpose is to indicate the apportionment of responsibility for mishaps between the electrical power engineer and his employers and for this purpose it sets out the duties and liabilities of the two parties. Attention is also paid to the position of independent contractors and third parties who may be involved in accidents.

This survey of responsibilities occupies the first six chapters of the book. There follow four chapters on the relevant sections of the Factories Acts—general safety provisions and the Electricity Regulations. The last two chapters briefly cover the subject of damages and safety practice within the Electricity Boards' organisation. An appendix gives advice on procedure after an accident.

As the introduction emphasises, this is not a legal textbook. It should be regarded as a guide to the avoidance of accidents and to the procedure if accidents unfortunately occur.—J.H.C.

Mathematics Applied to Electrical Engineering. By A. G. Warren. Pp. 464, illustrated. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 70s.

In the original edition of this book the author said in the preface that ". . . it is only within comparatively recent years that the mathematical needs of the engineer have been specifically recognised." That was in 1939 and the statement was correct if one interprets " comparatively" as then covering about 20 years and "specifically" as meaning books written solely for engineers. Since then, however, the output of books on engineering mathematics has increased phenomenally for the simple reason that engineering at its higher levels has acquired an ever-increasing mathematical content, and this applies to academic courses and to the work of engineers in industry and research establishments. There is now a more urgent need for greater accuracy of results, for speedier methods of calculation, and for techniques that embrace what might be called the mathematical engineering physics of the problem. It is true that much of the ground has been covered by specialist mathematical works, but often the engineer has little time to familiarise himself with them, and a book like the present one becomes of value.

The author writes as an engineer basing his writing upon his own long experience in the fields of engineering education and research. The new edition is a complete revision of the original, containing minor and major additions, deletions, and extensions that make it a very acceptable member of the modern electrical engineer's mathematical library. Briefly, it deals with real and complex numbers, differentiation and integration, fundamental electrostatic, magnetic and electrodynamic relations, electrical problems, harmonic and plane vector quantities including symmetrical components, differential and partial differential equations, general operational methods, Bessel functions, Fourier series and integrals, functions of a complex variable, operational calculus, and conjugate functions. There are four appendices on related subjects and a good index completes the work. The principal changes are in respect of the chapters on the operational calculus, Fourier analysis, and on functions of a complex variable. There is also now a section on analogues and one on analogue computers.

The book is primarily intended for the practising engineer and some little emphasis should be laid on this because it uses the c.g.s. system of units. The author does not yet appear to favour the M.K.S. system, although he presents a short summary of the relative merits of the two in the section on electromagnetism. In any case it would hardly have been worth while amending such a substantial portion of the book simply to give effect to the M.K.S. system, having in mind the principal class of reader for whom the book has been written. Engineering students, on the other hand, should have no difficulty in correlating the text with the M.K.S. system especially as the book is effectively a " methods " book and not an account of mathematical or engineering fundamentals.

This new edition is well recommended.—A.E.

BOOKS RECEIVED

Basic Electricity. Five parts. Pp. 5.117; figs. Technical Press, Ltd., 1, Justice Walk, London, S.W.3. Price 12s 6d per part, 55s per set.

The Technical Writer. By J. W. Godfrey and G. Parr. Pp. 340; figs. Chapman & Hall, Ltd., 37, Essex Street, London W.C.2. Price 45s.

Foundations of Electrical Engineering, Vol. II. By H. Cotton and E. W. Golding. Pp. 252; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 30s.

Fundamentals of Radio and Electronics. 2nd Edition. Edited by W. L. Everitt. Pp. 805; figs. Constable & Co., Ltd., 10, Orange Street, London, W.C.2. Price 57s 6d.

Die Schaltung der Leistungstransformatoren. By Fritz Andé. Pp. 332; figs. Springer-Verlag, Reichpietschafer 20, Berlin, W.35. Price DM 42.50.

Radio Communication. By W. F. Lovering. Pp. 536. Longmans, Green & Co., Ltd., 6 and 7, Clifford Street, London, W.1. Price 60s.

Transatlantic Telephone Cable Developments

TO improve communication for air traffic control and other aviation purposes on the North Atlantic routes, arrangements are being made to lay submarine cables between Newfoundland and Greenland and Greenland and Iceland in 1961 or 1962. The two links, each some 1,000 miles long, will be made with single cables fitted with British-pattern two-way repeaters to provide telephone and telegraph circuits in both directions. A cable for ordinary requirements between Scotland, the Faroes and Iceland has already been proposed by the G.P.O. and the Great Northern Telegraph Co. and one telephone and four telegraph circuits will now be reserved in this for aviation use. The Canadian Overseas Telecommunications Corporation and the Great Northern Telegraph Co. will be responsible for the Canada-Iceland link and countries with air lines flying the North Atlantic will pay a rental for its use. The three cables are expected to be made in this country and will together form the fourth transatlantic telephone cable.

The east-west transatlantic telephone cable which developed a fault on 21st February was repaired and restored to service last Sunday. A G.P.O. spokesman said that preliminary examination suggested that the cable was caught and broken by a ship's trawling tackle.

INDUSTRY AND THE HOUSE

Parliamentary Accountability of the Nationalised Industries

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

WHEN the Electricity (Borrowing Powers) Bill was discussed (some weeks ago) on second reading in the House of Commons Mr. Maudling, the Paymaster General, in answer to complaints from his own side that the period allowed was too long said it was right to adhere to a seven year limit. A little later (in the same debate) he also added it was " sensible " to take a seven year limit.

With this still in mind it was a little startling then at the Committee stage to find that Mr. Maudling had gone right about turn and was now prepared to agree that the industry should come back again to Parliament roughly in three and a half years' time—half-way through the borrowing programme envisaged by the Bill. Although the Paymaster General tried to treat the change as if it were the most natural and reasonable thing in the world, he was not allowed by the Opposition to escape quite so lightly. Labour members pointed out that a not-quite-so-secret meeting had taken place upstairs at which it was said Mr. Nabarro and his friends had made it clear to Lord Mills, the Minister of Power, that a shorter period must be introduced or else there would be trouble. Would the Bill in fact have been altered at all, Labour members asked, if the Paymaster General had been really free to follow his own course?

Effect of Amendment

But what difference will the alteration make in practice? I think very little. After all, the Bill, when an Act, will simply permit the industry to raise the ceiling of its borrowing powers; it does not say that the Boards should, or must, spend a particular sum of money. Everybody knows that when the nationalised industries are working out their forward programmes, capital requirements are scrutinised from year to year by the Treasury and this is far more likely to limit the activity of the industry than a formal requirement to seek another Parliamentary approval to borrow.

The fact is that although Mr. Nabarro's victory was a delight to the Opposition who thought they saw in it the weakness of present arrangements at the Ministry of Power, the change is little more than a symbol. Of course, Mr. Nabarro himself hardly helped matters by taking the entire credit for the Government's climb down.

However, as I have remarked before, these little ups and downs indicate on the surface a difficulty that goes deeper. Parliament still cannot make up its mind on the nationalised industries: whether they are to be publicly owned, commercial enterprises working in a competitive spirit within a free economy, or whether they are to be primarily public services. Whichever view is taken the industries must be efficient, but is efficiency to be guaranteed by normal commercial checks or instead by Whitehall administrative supervision? That puts the issue perhaps a little too baldly but there it is.

My own view is that public opinion in a Parliamentary system will not allow nationalised industries to escape in practice without a higher degree of public accountability than is in a sense necessary or even desirable. It is no good taking an idealistic point of view and saying that Parliament should keep out of it because it has neither the time nor the knowledge to exercise checks; that may well be so, but public affairs must be faced as they are and not as they should be. I favour as a reasonable compromise, therefore, the gradual development of a measure of Parliamentary accountability through the Select Committee on Nationalised Industries. Experience is already beginning to show that this can be effective, non-partisan and while properly within the Parliamentary orbit does not go beyond it. But the Committee must have an expert staff, which it lacks at the moment, to discharge its task properly.

Insurance Against Nuclear Accidents

Since I wrote last we have considered another measure of importance and interest to the electrical power industry. This is the Nuclear Installations (Licensing and Insurance) Bill which has had a second reading and will now go to Standing Committee " upstairs." When the committee gets round to the Bill I predict that many of the amendments to be discussed will be on its legal aspects.

The principal purpose of the measure as Mr. Maudling explained is to ensure that should an accident occur with a nuclear reactor all those harmed as a result in life, limb and property should be adequately compensated. Mr. Maudling thought the possible dangers extremely remote but he agreed that should the worst come to the worst the damage might be of a serious order. It was, therefore, essential to take all possible precautions by licensing, control and insurance. All owners of nuclear installations, including the Central Electricity Generating Board, would have to cover an absolute liability for hurt or damage from a radioactive substance escape. Such hurt or damage could take a long time to become apparent. Hence, the Government had bowed to suggestions made in the House of Lords that the period for claims be extended to thirty years as against the original ten years. Owners would have to insure up to five million pounds, but beyond that figure the risk would have to be carried under arrangements yet to be made by Parliament. Mr. Maudling emphasised that staff and workpeople in nuclear plants were protected by a right to compensation just as absolute as that of the general public.

A useful discussion ensued in which honourable Members taking part could be divided into two camps: those who tended to hold an optimistic view about the possible risks and those more anxious to be prepared in advance rather than sorry afterwards. A point made by the writer during the debate was that the design of nuclear power stations should allow from the start for the need completely to evacuate all workpeople and staff should a radioactive outbreak occur.

Tin Plate Workers' Awards

The Worshipful Company of Tin Plate Workers alias Wire Workers of the City of London announces that the first place in the essay competition among those awarded travelling scholarships, 1958, has been gained by Mr. T. Dale employed by Yorkshire Imperial Metals, Ltd., Leeds. The second place goes to Mr. B. Randles employed by John Thompson, Ltd., Wolverhampton, and the third place to Mr. T. Marston employed by the Central Electricity Generating Board, Yorkshire Division, Leeds.

Ideal Home Exhibition

ON Tuesday last the annual *Daily Mail* Ideal Home Exhibition opened at Olympia and as in previous years the display of electrical equipment and appliances is one of the major attractions. Many of the leading electrical domestic appliance manufacturers are represented and the impression gained, as the result of our visit, is that from an electrical point of view, there appears to be an all-out effort on the part of the manufacturers to provide the housewife with not just an ideal home—but an automatic ideal home. On the Electrical Development Association's stand, for instance, the display of electric cookers includes thirteen automatic models, while in another section fully automatic dishwashing machines and home laundry equipment can be seen. Altogether the E.D.A. stand has over 130 domestic electrical appliances on view, including many which are entirely new. "Electricity is Cheap Enough" is the theme of the Association's display and in a section of the stand given over to floor warming the electric under-floor heating method is demonstrated. Figures prove its low operating costs in various housing schemes where it has been installed. Under-carpet heating for existing houses is also introduced in this section.

A built-in electric cooker is a development new to this country and a complete kitchen layout, designed by Tricity Cookers, Ltd., has been evolved especially for the exhibition to demonstrate its possibilities. Basically, the equipment consists of three sections: an oven incorporating an auto-time switch control and minute timer; a hotplate section; and a warming cupboard. This enables designers, architects and builders to install the units in any desired position in the kitchen and at a convenient height. There is, in fact, nothing to prevent the oven and hotplate sections being placed in different parts of the room. Limited supplies of this new cooking equipment will, it is anticipated, be available in the autumn.

A new cooker in the medium-price bracket is shown by the G.E.C. Named the "Superb," it is claimed to be the first to combine a drop-down oven door with a full-view inner glass door to the oven. Both doors are separately counterbalanced and a removable plated grid enables heavy dishes to be drawn on to the door without fear of damage. The company's "Supreme" cooker with eye-level grill and the "Quality" cooker with a sliding grill pan holder are also to be seen on this stand.

A glass-walled kitchen is the central feature of the English Electric display. Completely equipped with the company's four major appliances—automatic cooker, washing machine, clothes dryer and refrigerator—as well as fitted kitchen units, etc., it illustrates how the present credit terms make it possible to have a labour-saving kitchen at a reasonable cost. The cooker, incidentally, apart from an oven light and interior glass door, is now fitted with 8in and 6¼in quick-boil "Veeline" radiant hotplates, controlled by simmer switches, at no extra cost.

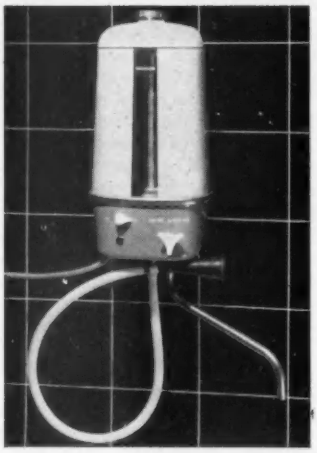
Belling & Co. are also showing new electric cookers but details of these were not available at the time of our visit.

Refrigerator Developments

Probably the outstanding feature of the new refrigerators on show is the care that has gone into the arrangement of interior fittings to make use of every available inch of storage space whilst keeping exterior dimensions to the minimum. Adjustable shelves help to achieve this whilst some models have hinged half-shelves, and flaps for holding small packets. The new 2½ cu ft absorption type refrigerator introduced by the G.E.C. is one such refrigerator which stores a surprising amount of food for its size. It has over 5½ sq ft of shelf area and is styled in the new "squared-up" fashion, with no protruding handle. For the housewife who requires only a small cabinet but with most of the features normally associated with the larger and more expensive models, Kelvinator offer their new K46JT. It is a table-top model, the top being covered in "Warerite" with a neat chromium trim, with the door so hinged that it opens within the external width of the cabinet. The capacity is 4·6 cu ft. In all there are five new models in the Kelvinator 1959 range, the largest being a luxury model with a 9·1 cu ft capacity and fitted with an automatic push-button defrosting system.

A colour-cool interior finish is the keynote of the new Frigidaire range with contrasting white, light blue and "pearlescent" dark green interiors. The company's popular 3·3 cu ft model (MZ-33) now has more shelf area than earlier similar-sized models and incorporates a special action safety handle and a door gasket which is claimed to reduce heat leakage to the minimum. It is available in

Left: Frigidaire model MZ-33 3·3 cu ft refrigerator. Centre: G.E.C. 2½ cu ft refrigerator. Right: Kenwood "Automatic Dishmaster" dish-washing machine



Simplex "Creda Corvette" water heater

four variations—free standing or for building in, and with left- or right-hand door opening. The largest model in the Frigidaire range is the DZ-101 (10·1 cu ft) and all are operated by the company's exclusive "Meter Miser" rotary compressor.

The secret of the ease of movement of the A.E.I. Hotpoint "Pacemaker" refrigerators is in the rollers fitted to the base of the new models, the D36 (3·6 cu ft) and D50 (5 cu ft). Prest-cold display for the first time the "Luxury Six," a 6·7 cu ft refrigerator with many refinements including adjustable feet, flush-fitting lock, and gold anodised shelf edges. The company is also showing two "Prestofreeze" home freezers (5¼ and 10¼ cu ft).

Refrigerators and freezers are shown by Lec Refrigeration, Ltd., while the Electrical Division of Radiation, Ltd., introduces the "Jackson 202," a contemporary-styled 2 cu ft model with a non-chip plastic cabinet moulded in one piece. Perhaps the most spectacular newcomer to the Electrolux absorption range is the model L.26, a 2½ cu ft refrigerator capable of storing nine pint bottles of milk on its upper shelf.

The latest "Dishmaster" dish-washing machine announced by the Kenwood Mfg. Co., Ltd., is a fully-automatic model which can be pre-set for a six-minute wash-up, or less, and having washed for the predetermined time, drains the dirty water, rinses with clean water for two minutes, drains again, gives a second rinse, then dries for four minutes and switches off. The running cost is approximately 1s per week and about three gallons of water is used each time. The Dishlex Division of Scotts Engineering (Newport), Ltd., has redesigned its automatic dish-washer and the first of the new models is introduced at the exhibition. This "Dishlex Automaid" is designed to give complete safety to the housewife—the motor switches off and the water drains away if the lid is raised during the operation.

The latest "Creda" domestic appliance by Simplex Electric is the "Corvette" water heater, designed for fixing on the wall or window sill near the kitchen sink for providing water, from warm to boiling. It is fed with cold water by means of an adjustable hose from any sized water tap and any quantity from a cupful to a gallon can be heated at one time. It has a 3 kW element fitted in the base; a flask of heat-resisting glass, graduated in pints; and a 9in swivelled spout. A pilot light indicates when the set temperature is reached and, for tea making, a whistle warning sounds when the water boils.

It is claimed by Darragh, Smail & Co., Ltd., on whose stand the "Teaboy" 3-in-1 kettle, teapot and hot water jug is shown, that tea can be prepared overnight, ready for use next morning. Water is placed in the anodised aluminium jug (capacity three pints) and the tea in a separate container in the upper part. The electric model (1,200 W) is plugged in in a similar manner to an electric kettle and when the water boils the tea can be poured out. As the water and tea leaves are kept apart the tea is said never to be "stewed," however long it is left.

The number of electric spin dryers on the market continues to increase and two more models have been introduced at the exhibition. On the "Goblin" stand (British Vacuum Cleaner & Engineering Co., Ltd.) the "Spin-Quick" is displayed. A neat cabinet machine, it has a dry clothes capacity of 6 lb and the drum speed is 2,800 r.p.m. The finish is in white, with light blue trim. The other newcomer is the "Rinspin" shown by Servis Domestic Appliances. This is claimed to have a new "deep rinse" action achieved by means of a series of slots in the top casting, instead of the usual perforations in the side of the drum. Speed of the drum is 2,200 r.p.m. and the finish is in white with grey trim.

For the built-in kitchen a multi-purpose kitchen aid, the "Power Maid," demonstrated by Cannon E.A., constitutes a single six-speed power unit which operates a variety of labour-saving devices including a full-size food mixer, a blender, a juicer and a knife sharpener. It is designed to fit into the top working surface of the kitchen cabinet and covered by a stainless steel plate with recessed

Cannon "Power Maid" multi-purpose kitchen aid

multi-speed switch and power drive. When not in use it is out of sight, occupying no table space, but is always ready for instant use. Further attachments are expected to be available in the future.

Comfort heating for every season is the theme of the Dimplex display where infra-red heaters in the form of 750 W wall-mounting and 1,500 W floor-standing models are on view in addition to oil-filled electric towel rails and radiators in various sizes. Electric heating is offered in a variety of forms on the "Ekco" (E. K. Cole, Ltd.) stand while Berry's Electric, Ltd., feature in addition to "Magicoal" fires in period and modern designs the

Wolf "Rotamix" rotary mixer

"Chameleon" winter and summer fire, which changes colour automatically through a sequence of tones—warm red for winter or cool green for summer. Mention should also be made of the wide range of traditional and contemporary lighting fittings on this stand, and also of several imported fittings noticed on the stand of the Federal Republic of Germany, seen in the International Section. The last-mentioned fittings can be obtained in this country from W. Logan & Co., Ltd.

Finally, for the home handyman several attachments are shown by S. N. Bridges for their "Neonic" safety drill, the most recent being a paint sprayer attachment, which incorporates a lightweight compressor developing a pressure of over 100 lb/sq in; and a power mixer attachment designed to take the hard work out of mixing. It is said to mix small quantities of cement, concrete, paint, etc., as well as poultry foods, mashes, etc. No special container is required—an ordinary household pail will suffice. Wolf Electric Tools, Ltd., feature their "Rotamix," a drum-shaped container for the mixing of concrete, mortar, fertilisers, feeding stuffs, etc. It can be powered by the "Safetymaster" or "Quartermaster" home power units or the company's industrial ¼in drill. The drive is transmitted from the power unit via a reduction gearbox. Capacities are one bushel for dry-mix materials and ¾ cwt for wet-mix materials.

UNSAFE PREMISES

Liability of Electrical Contractors and Owners

By F. E. SUGDEN

ELECTRICAL contractors who are called upon to overhaul electric lifts are affected by a recent decision of the Court of Appeal.

Briefly, the facts of the case were these. The injured person was employed by a firm of contractors who had contracted with the owners of premises to maintain a lift on their premises. This employee had paid many visits to the machine house on the roof above the lift, gaining access to it through a pair of doors to which a ladder led. This employee was unaware that the left door of the machine house was in a defective condition although it had been mentioned by the contractor to the owners of the premises. Neither the owners nor the contractor repaired it. Moreover, the contractor did not visit the premises to see whether the place of work and access to it were safe for his own employees.

On a specific date the employee, who claimed damages later, found that the lower hinge of the left door at the entrance to the machine house was broken. He therefore tied the doors together with wire to keep them closed. Later he, with two other employees, went to the premises to check the electrical contacts and he then found that the right door was open and that the left door was jammed inside the machine house. When he put his weight on the left door to lever himself up, the door gave way and he fell from the ladder and was injured.

Subsequently he brought an action in the High Court against both his employer and the owner of the premises for damages for personal injuries. An amount was awarded to him apportioned between the employer (20 per cent) and the owner of the premises (80 per cent). The case went to the Court of Appeal which reversed the High Court judge's decision.

The employee then appealed to the House of Lords which came to the conclusion that the contractor (the employer) was liable in damages to his employee because the High Court judge had come to the conclusion that the contractor was negligent in not having visited the premises where the lift was installed to see that the "place of work" was safe for his staff. This conclusion was reached in spite of the fact that the employer had visited the premises on four occasions and had notified the owner of the premises of the need to repair the doors of the machine house. He should have seen that the repairs had been carried out.

The House of Lords also ruled that the owners of the premises were also liable to the injured employee for damages (as the employee was deemed in law to be an invitee) on the ground (*a*) that the jamming of the left door created an unusual danger for the injured employee, the risk of which he did not fully appreciate and the inference was that the jamming of the door was created by the agents or servants of the proprietors of the building and was a danger which the owners of the premises knew about and should have guarded against; and (*b*) that the injured employee had not fully appreciated the nature of the risk created by the jamming of the left door and thus was not excluded from recovering damages for the failure of the owners of the premises to take reasonable care that the premises and the means of access to the machine house were reasonably safe. The damages were apportioned between the employer and the owner of the premises, as determined by the High Court judge.

This case shows the necessity for an employer or a competent member of his staff to inspect the conditions under which employees work when they are sent out on a job, to make sure that the premises are safe. If the owner of the premises on which an electrical contractor's employees work refuses to carry out the instructions of the contractor for the safety of his men, then the contractor must immediately withdraw his staff from the premises which are deemed unsafe.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

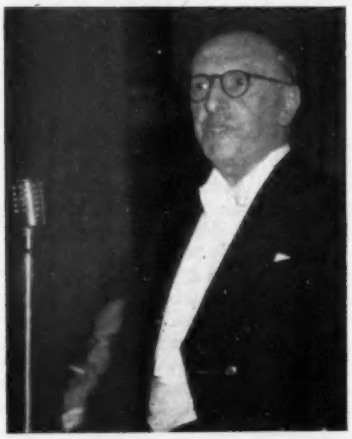
ALUMINIUM ingots	ton	£180 0s 0d
COPPER, H.C. Electro	ton	£241 15s 0d
Fire Refined 99·70%	ton	£240 0s 0d
Fire Refined 99·50%	ton	£239 0s 0d
COPPER Tubes	lb	2s 3½d
Sheet	ton	£271 0s 0d
H.C. wire and strip	ton	£291 5s 0d
LEAD, English	ton	£70 15s 0d
Foreign	ton	£69 0s 0d
MERCURY	flask	£74 0s 0d
TIN, block (English)	ton	£782 10s 0d
ZINC, G.O.B. Foreign	ton	£75 15s 0d
BRASS Tubes (solid drawn)	lb	1s 10¾d
Wire	lb	2s 8¼d
PHOSPHOR BRONZE Wire	lb	4s 1⅛d
PLATINUM	oz	£25 0s 0d
RUBBER, No. 1 R.S.S. spot	lb	25⅝d—25¾d

THE I.E.E. AND EDUCATION

Main Theme at Annual Dinner

PROPOSING the toast of the Institution at the I.E.E. dinner, held at Grosvenor House, London, on 26th February, the Lord Chancellor, Viscount Kilmuir, referred to the appeal which the Government had launched for assistance in founding a college of engineering technology in Delhi and thanked the Institution for its help. So well, he said, had its leading members promoted the advancement of electrical science that they had converted public opinion to the view that proficiency in electrical engineering was as "U" as literary scholarship. The danger today was not that new forms of specialised education would be refused recognition but that all education might become too narrowly specialised. From the very beginning of education people must learn to speak each other's technical languages and not become exclusive and ostrich-like jargoneers. The more this was done, the more likelihood there was of making this difficult world of the second part of this mad century an intelligible as well as an intelligent world.

The President (Mr. S. E. Goodall), responding, referred to the scientific contribution which the Institution was making through the medium of international conventions and discussions. The response of experts both at home and overseas had been most encouraging, he said, and it was intended to extend this activity as much as possible. They were happy to be associated with the project for the new engineering college at Delhi. The appeal had yet to be launched on an unsuspecting industry and would be mainly the responsibility of the Federation of British Industries, but Sir Willis Jackson (a vice-president of the Institution) was chairman of the committee which was making the arrangements. The only criticism which he had heard was that conceivably India was planning to produce too great a porportion initially of professional men in the engineering field. If this were so—and he doubted it—other Commonwealth countries would, he was sure, be happy to absorb the surplus, because they were all suffering from a marked shortage of professional electrical engineers. The White Paper of 1956 forecast that by 1959 30 per cent more such engineers would be required in this country. There had been a marked increase in the number, but that target had not been reached.



The President replies to the toast of the Institution

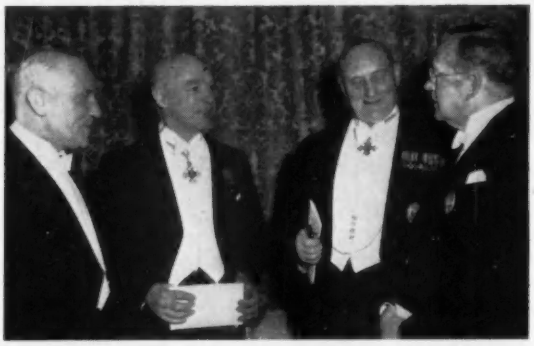
The Institution had collaborated with the National Council for Technological Awards and was happy that the Council was now paying attention to specifying more closely the requirements for the practical part of the sandwich courses. Very soon the chief difficulty was likely to be that, while there were sufficient places in the technical colleges, the parallel training in industry was likely to be deficient in quantity, and even now it was not always what it might be in quality. An appeal had recently been made to the smaller and perhaps more specialist firms to follow the example which had been set particularly in Scotland of groups of companies getting together to organise a co-ordinated scheme in conjunction with the local technical college.

Mr. T. E. Goldup proposes the health of the guests

There had apparently been some misunderstanding, particularly in the provinces, of the recent changes in Institution regulations regarding the grant of exemption through National Certificates. The principle behind those changes was a wish to insist on the courses of instruction standing the young men in good stead in their subsequent professional careers. There could be little doubt that some at any rate of those who had qualified through this channel had been at a considerable disadvantage by comparison with their university confrères.

Referring to the change in the title of the Radio and Telecommunication Section to "Electronics and Com-

Sir Norman Kipping replying for the guests. On his left are the Ambassador for the Republic of Ireland (Mr. H. J. McCann) and the Mayor of Westminster (Councillor D. Cobbold)



Left: The Lord Chancellor (Viscount Kilmuir), Mr. W. K. Brasher (secretary, I.E.E.), Mrs. Pandit (High Commissioner for India) and the President. Right: Sir John Pickles, Mr. C. T. Melling, Col. Sir Stuart S. Mallinson and Sir John Hacking

munication Section," the President remarked that the word " electronics " was not a happy one and its meaning was obscure, but it had become well established by usage. The Institution, feeling that in large measure the basic education of electrical engineers should be common, drew no distinction between electronic engineers and electrical engineers. The applications of electronics were so wide that they impinged on the fields of the other three Sections of the Institution, and there was no intention of diverting papers on specific applications from those Sections. This would not be the last change in the structure of the Institution, and consideration was already being given to the next step to be taken to demonstrate clearly to young men attracted by the electronics field that they could find all that they wanted at the professional level in the Institution.

Finally, the President referred to the rebuilding now going on at Savoy Place, which, when completed by the end of next year, should provide first-rate facilities for conventions, exhibitions and the like. Although a large sum of money was being spent on these operations, he gave an assurance that there would be no appeal either to industry or to the membership.

Mr. T. E. Goldup, in proposing the toast of the guests, and referring to the absence of the Soviet Ambassador, said that engineers in this country knew a good deal about the contribution which their counterparts in the Soviet Union had made and were making in the spheres of science and technology for peaceful purposes, and also about what they had done in the field of education. He also made an appreciative reference to Mrs. Pandit, High Commissioner for India, who was present.

Sir Norman Kipping, in reply, said that two years of talks about European trade had made him familiar with another new jargon, in which " harmonisation " indicated a high degree of lack of harmony, while " discrimination " and " preference " were terms which had their dictionary meaning when practised by other countries, but when practised by one's own took on a diffused glow, hallowed by long usage in Commonwealth relations. Referring to the Delhi project, he said that the British electrical industry had a record second to none in the financial support which it had given to selected educational purposes. The operative word was " selected," and the Delhi project fell into that category. If leading firms sometimes felt that they were regarded as milch cows and expected to stand patiently in the stall and be milked of very large sums by the most modern methods, it was not surprising. British Governments, whatever their colour, leaned heavily on British industry, but should be careful not to make the cow sick or stubborn by over-milking. The best way for the Government to help the campaign would be to afford donations special consideration for tax purposes.

The attendance at the dinner was in the region of 1,500.

FARADAY MEMORIAL

A LARGE-SCALE redevelopment scheme is being carried out by the London County Council at the " Elephant and Castle," Southwark. This work will necessitate the re-siting of an existing London Transport electricity substation and it has been suggested that this would provide an opportunity to set up a physical memorial to Michael Faraday, whose birthplace was close by. Last year a committee of interested organisations discussed a plan to rehouse the substation in an attractive building, 25-30ft high, on the larger of two island sites, with a commemorative monolith recording details of the scientist's life and achievements.

At a further meeting last week it was reported that the cost, additional to that of re-siting the substation in a normal, probably underground, building, would be £18,000, with a further £3,150 for the monolith. It was agreed that the learned societies and institutions concerned with the work of Faraday should be asked if they would sponsor an appeal for such a memorial, with which the Borough of Southwark would be associated, as part of a larger appeal to be devoted to educational work. Sir Josiah Eccles (Electricity Council) said it would help if the " Elephant " could be called Faraday Square or Circus. The Town Clerk of Southwark (Mr. E. J. Pitt) said that he would make inquiries on that point although it might be difficult to change such a well-known name.

Electric Lamp History

IN a lecture entitled " Sir Joseph Swan and the Development of the Electric Lamp," which he gave at Newcastle-upon-Tyne recently, Dr. J. N. Aldington surveyed the activities of Swan in the photographic and lighting fields. He said, " My investigations into the unique contributions made by Edison and Swan cause me to state most categorically that it was Swan who made the fundamental step in the invention which resulted in the carbon filament lamp, precursor of the electric lamp today."

This lecture was presented as part of the golden jubilee celebrations of the Illuminating Engineering Society and, in a room adjacent to the lecture theatre, Siemens Edison Swan, Ltd., staged an exhibition of historic lamps which included one of the original batch of lamps made by Sir Joseph Swan.

Germanium Rectifier Manufacture

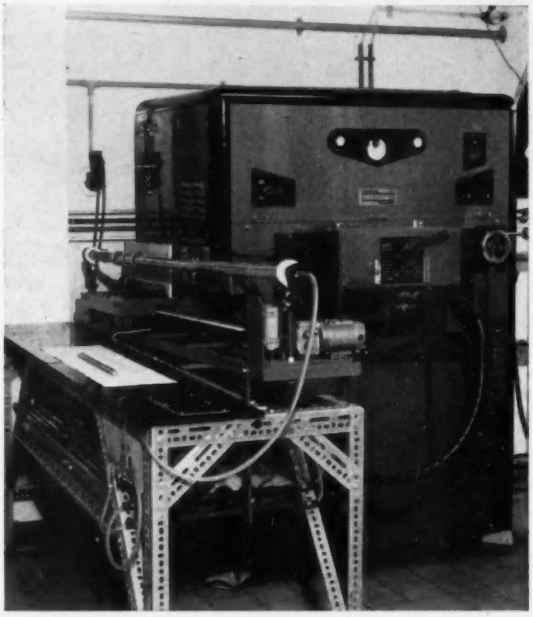
After over 50 years' manufacture of high power mercury-arc rectifier equipment the Hackbridge & Hewittic Electric Co., Ltd., has now enlarged its facilities to include the supply of rectifiers employing semiconductor elements for low- and medium-voltage applications, and has in full production an extensive department for the complete manufacture, assembly, and testing of germanium diodes of the air-cooled and water-cooled types for use in Hewittic rectifiers

SOME years ago the possibilities of the germanium semiconductor rectifier were recognised by the Hackbridge & Hewittic Electric Co., Ltd., and a programme of research and development was undertaken. As a result, plant has now been installed in an extension to the Walton-on-Thames works in which every facility has been incorporated for the most effective production of germanium rectifiers.

Since the correct working of a germanium diode depends upon the presence of small amounts of known impurity elements it is necessary, before these elements are added, to start with extremely pure germanium. To achieve this end the zone refining technique is employed.

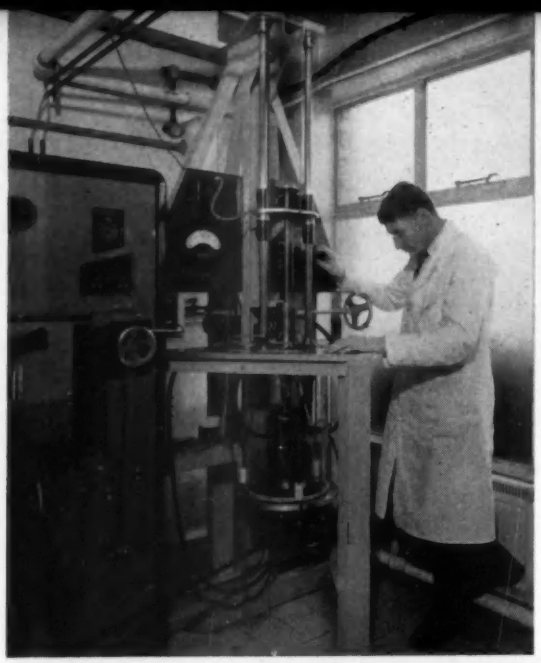
An ingot of germanium and its containing crucible are placed in a hydrogen atmosphere in a long quartz tube. This tube is surrounded at intervals by three r.f. work coils which are arranged to travel together slowly from one end of the ingot to the other, so causing three molten zones about an inch wide to move along the bar in one operation. Any impurities present tend to remain in the liquid metal rather than move across the liquid/solid interface at the trailing end of the zone, and this results in their being swept to the end of the bar.

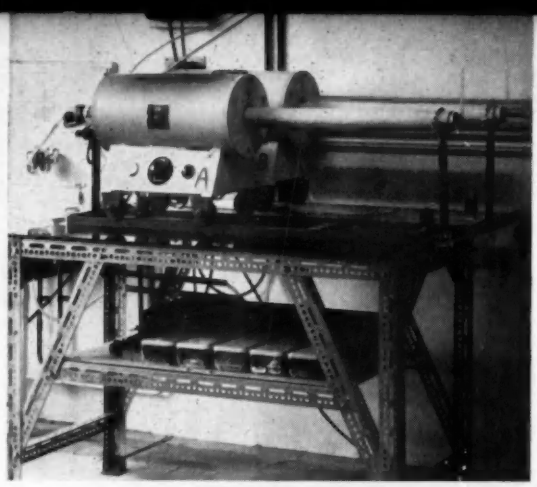
The presence of impurities is detected by resistivity measurements made along the axis of the bar whereupon they can be removed by cutting off the end at a suitable point. These measurements are made at regularly spaced intervals on a line ground along the back of the ingot. The germanium is brought into contact with four independently sprung and accurately spaced probes situated in the instrument head. The outer probes pass a controlled current of 1 mA, and the resulting volt drop on the inner



Apparatus for zone refining germanium ingots

Electrical measurement and testing room





Above : Twin furnace alloying bench
Left : Machine for pulling crystals from the melt by the Czochralski method

probes is measured by a sensitive reflecting type galvanometer directly calibrated in ohm-cm.

To produce an ingot of metal which is wholly single crystalline it is necessary to control solidification atom by atom. This is achieved in a special machine in which the germanium is first melted in a cup-shaped quartz crucible, by means of an r.f. work coil supplied at 400kc/s. A long thin piece of specially prepared single crystal germanium (the " seed ") is then lowered into the surface of the molten metal. Carefully controlled conditions keep the temperature high enough to melt the tip of the seed and low enough for a meniscus of liquid germanium to be held up from the molten metal by surface tension forces. The temperature loss through the chuck of the machine securing the seed causes the solid/liquid interface to move slowly down from the seed into the general mass, and when a sufficient diameter of solidification has formed around the tip of the seed, the seed is slowly and continuously raised. This results in a growing column of solid germanium being pulled up from the melt to be left hanging from the seed as a single large crystal.

The operation is carried out in an atmosphere of specially dried high-purity hydrogen, and this results in the formation of very clean and bright crystals. Seed rotation and pulling is effected by constant-voltage motors and the seed spindle and main plate are water cooled. Initial seed dipping is effected manually. The introduction of antimony to produce an N type crystal is done during crystal growing by adding to the crucible a carefully calculated and weighed amount of this metal.

The completed crystal is shaped into a square-sectioned stick and cut into 0·03in wafers by means of a small precision diamond saw of the type used for cutting diamonds. Both surfaces are then lapped to bring the thickness to 0·02in. Every wafer used is centred on the crystal centre so that its isorhos are concentric. This gives the beneficial result of a symmetrical current density pattern. Finally, the discs are cleaned and given the necessary surface finish by etching in acids, washing in running de-ionised water, and drying by infra-red heaters.

At this stage the rectifying junction is made. On one side of a disc of N type single crystal germanium a slightly smaller disc of indium is placed and the whole is brought up to a temperature greater than the melting point of indium (155 deg C) but less than the melting point of germanium (980 deg C). The germanium and indium wafers are loaded and jigged in graphite blocks in batches and alloyed inside quartz tubes under an atmosphere of hydrogen—as with zone refining and crystal pulling.

The electric furnaces surrounding the tubes are arranged so that they can be temperature stabilised before being moved along the tubes to the positions where alloying is to take place. This results in junctions of very regular characteristics, and simplifies the controls required.

The liquid indium quickly dissolves germanium up to saturation point, and upon cooling, the dissolved germanium precipitates out of solution and recrystallises back on to the base germanium. This recrystallised layer of germanium now contains a larger number of indium atoms than it originally did of antimony atoms, and has thus been converted to P type so that it forms a rectifying junction with the N type base germanium.

The rectifier junction has to be protected against contamination from all likely industrial atmospheres, and to this end it is hermetically sealed in a glazed ceramic tube which also serves as an insulator between the anode and cathode terminals. The tube is attached to the copper heat sink after the latter has been treated by abrasive vapour blasting for cleaning and finishing.

Encapsulating of the junction in the heat sink is carried out on plastic-topped benches in an air-conditioned room in which a high standard of cleanliness is maintained. Before the final seal is made the diode is cleaned with specially filtered compressed air, and finally vacuum dried. In the case of the air-cooled units, the diode is made as an integral whole, with the junction soldered directly on to the heat sink-cooling assembly—there are no separate cooling fins or attachments. By this means a low thermal resistance is assured and hot spots are avoided.

Electrical measurements and testing are carried out in a specially equipped test room, where routine tests of reverse and forward characteristics are made for the purpose of grading each diode. This is followed in every case by a load test in a single-phase, half-wave, resistance load circuit, during which the diode is tested according to its grading. In addition, by means of a special circuit, its on-load reverse current is observed and recorded.

Many Hewittic germanium rectifiers employing these diodes have already been supplied for such duties as d.c. supply to electro-chemical processes and for various works load applications. At the same time the company is engaged in the manufacture of rectifier equipments using silicon diodes, both for low-voltage applications where the temperature is high, and for use at higher voltages.

Performance of Arc-Chutes

By
J. S. MORTON
B.Sc.*

Summary of a paper entitled "Development of High-Voltage Air-Break Circuit-Breakers with Insulated-Steel-Plate Arc-Chutes," by F. S. Fay, M.A., J. A. Thomas, B.Sc., D. Legg, B.Sc., and J. S. Morton, B.Sc., which was read before the Supply Section of the Institution of Electrical Engineers on 25th February

THE insulated-steel-plate arc-chute was developed as a result of considerable research into the behaviour of arcs and arc extinction in air-break circuit-breakers. The arc-chute is shown in Figs. 1 and 2 and comprises a number of slotted plates closely spaced inside an insulating box which is open at the top and bottom. Each plate consists of a thin sheet of steel moulded and completely embedded inside a plate of mica and glass. The steel sheets provide the magnetic circuit which is energised by the arc from the instant it is established and produces the driving force up the chute. At the top of the slots in the arc-chute plates, the arc is lengthened by being forced to follow a compact zig-zag path and is cooled by the plates and the surrounding air. The exhaust gases are further cooled by the cooler on top of the arc-chute plates.

Arc extinction is achieved because the arc resistance at current zero is high enough and increasing at a rate fast enough to prevent the continuance of power-frequency currents. The arc resistance during the post-zero period is low enough to damp the system restriking voltage transient so that extinction occurs with a thermal clearance and appreciable post-arc conductivity, whereby the energy input into the arc during the flow of post-arc current depends mainly on the instantaneous recovery voltage.

The behaviour of arcs in the arc-chute was judged from a few ultra-high-speed ciné films, several thousand high-speed ciné films and many more oscillograms. It was observed that during the life of the arc the formation of new arc cores occurred. This was due to the resistance and arc voltage of an old arc core being sufficient to establish a new and shorter arc core farther down the chute, the two cores being in parallel for an instant with the old arc dying out as the new one was established. This was observed at arc initiation and ceased when the contact gap was sufficient to withstand the arc voltage of the old core and allowed the arc to proceed up the chute. When the arc reached the portion of the chute where the arc was stretched, the formation of new arc cores again occurred. Arcing in the slots was then a process of arc cores being stretched and dying out as new cores of shorter length were established lower down the slots.

This process was not detrimental to the performance of the arc-chute since the arc was always under control, but a process of the formation of branches extending from existing arc cores was found to be harmful in the performance of the chute. These branches, called downstrikes, formed after the arc was established up in the chute and appeared as streamers from the arc core moving down rapidly and impinging on the moving contacts and runners. The voltage appearing across these streamers is that of the arc voltage in parallel with it and, at the centre of the chute where this voltage is greatest, an arc can be formed along the path of a streamer. The new arc has a much shorter length than the stretched portion in parallel with it, and becomes established as the old core dies out leaving only half the chute in use. It was found with the insulated-steel-plate arc-chute construction that this downstrike could stay in this position if it moved into the space between adjacent plates or was initially established in that space. This was prevented by reducing the space between the plates in that portion of the chute, so that when downstrikes occurred the new arc core remained under control and returned up into the chute again.

Having ensured that the arc was at all times under control, i.e. when a new arc core formed it returned to the position of the old one in as short a time as possible,

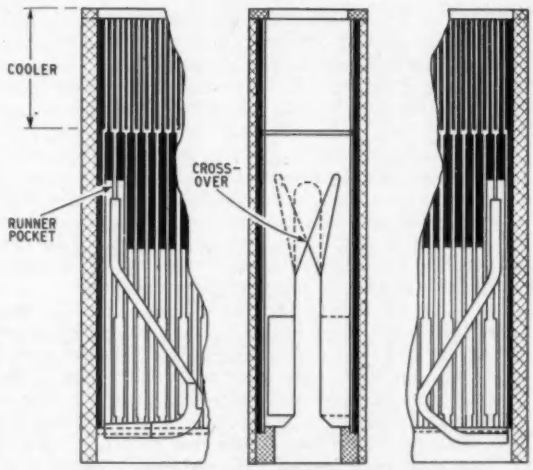
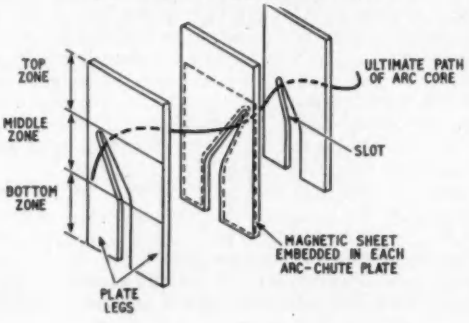


Fig. 1.—Sections of an insulated-steel-plate arc-chute

Fig. 2.—Exploded view of arc-chute plates



* A. Reyrolle & Co., Ltd.

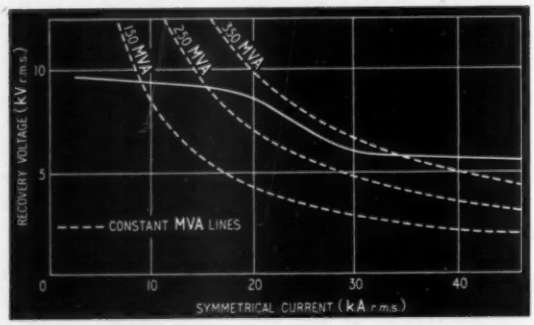


Fig. 3.—Voltage/current characteristic

very consistent performance was obtained with the arc-chutes. The voltage/current characteristic of an insulated-steel-plate arc-chute is shown in Fig. 3, and this characteristic can be explained in terms of the chute parameters enabling arc-chutes to be designed for specific ratings with considerable accuracy.

A consistently good performance has been achieved with the insulated-steel-plate arc-chute which is mainly due to the driving field produced by the steel plates being available throughout the whole of the arcing period so that at all times the arc is kept under complete control. Furthermore, the arc-chute is of simple construction and has been proved suitable for voltages not only up to but above 15 kV.

DISCUSSION

Mr. C. H. Flurscheim (Metropolitan-Vickers) said that compressed air was almost perfect as an interrupting medium and considerable success had been achieved in substituting it for oil. At first sight, there would seem little incentive to the engineer to use air at normal pressure but it had two main advantages—the elimination of explosions arising from fire and easy contact maintenance. However, explosions were virtually unknown with modern oil breakers even though the possibility might exist. In his opinion, the air-break circuit-breaker, though a device on which work should undoubtedly continue, had not yet reached the stage of equality with the oil breaker except in the respects to which he had referred.

Mr. J. A. F. Harvey (English Electric) felt that the authors had not done justice to the amount of work carried out and their explanation of the choice of interrupter was too brief. The interrupter philosophy of his company was firstly to use bare-metal-plate arc chutes for as high a voltage as possible because of their good peak capacity. They had an inherent attraction for the arc and they were simple. He outlined a number of points on which he was not in agreement with the authors.

Mr. A. H. Pollard (British Thomson-Houston Co.) said the authors had done less than justice to other types of chute. He had been associated with investigations into a bare-metal type and the results were different from those of the authors. They had said a lot about contacts and current-carrying capacity but not much that was new. The amount of current that could be dealt with successfully depended upon configuration and proportions among other things, and there were thousands of breakers in existence which were dealing successfully with the currents and materials indicated in Fig. 5 of the paper. Whether the magnetic material was covered with insulation or not made no material difference to the control of the arc before it went into the plate.

Mr. C. W. Mott (C.E.G.B.) said there were probably three or four different arc chutes in course of development. Within quite small margins no doubt they would all be as good as one another. He did not think there need be any more discussion, therefore, as to the choice of chute. It was his experience that while tremendous advances were being made, the oil circuit-breaker as known today would need some beating at all voltages for reliability. While the authors might have described theories that were not new, they had put them on a sounder technical basis than they had had before; for this they deserved great credit.

Mr. M. P. Reece (E.R.A.) remarked that the arc chute described, ingeniously combined the magnetic sucker plate used in other types and the ceramic chute with very successful results. There was no doubt that if it eliminated the cost of blow-out structures it was of great advantage.

Mr. J. Solomon (C.E.G.B.) said that to one who had been concerned with the application of circuit-breakers to power station auxiliaries there had been a dramatic change in the designs recently available. For the larger generators higher voltages were required because of increasing currents. Oil circuit-breakers had been proved over a period of years and it was a pity the authors had not said more about the inherent advantages of air-break circuit-breakers. They might also have given more details of construction.

Mr. C. J. O. Garrard (G.E.C.) said it was not difficult to get arc chutes to work if the current was sufficiently large; the real difficulty was with a few amperes. Engineering had often been described as the art of combining science with economics but so far that evening little attention had been devoted to the latter. It seemed to him that air-break circuit-breakers were going to be larger in the future than the corresponding oil circuit-breakers. They would contain more expensive material in larger quantities and on the whole they would be more complicated. Would the air-break circuit-breaker at voltages of the order of 10 to 20 kV really prove to be a more economic job and therefore a better engineering job?

Mr. Fordham Cooper (H.M. Inspector of Factories) pointed out that the most common failures on circuit-breakers were not failure to clear the rated rupturing capacity but mechanical failures, such as fatigue stress in parts used too often and insulation failure. Mechanical failure frequently led to insulation failure. He had an open mind at the moment about the reliability of air-break circuit-breakers, but they did not explode and destroy the whole building. Distribution engineers, though they should not do so, sometimes reclosed oil circuit-breakers more than they should: he had read a report of one that had been reclosed five times. Would air-break circuit-breakers be capable of being reclosed five times?

The chairman commented on the difference in practice in this country and the United States. There air-break switchgear was generally used in the lower voltage ranges and at any rate until recent years oil gear for the higher voltages. In this country it tended to be the reverse.

Cold Arc Calculations

The work described in E.R.A. reports Refs. L/T330 and 331 has been continued and is dealt with further in report Ref. L/T362 " Stability, Re-ignition Time and other Features of the Cold Arc " by A. E. Robson (price 6s). A qualitative method of calculating the equilibrium current density is given, and the importance of oxide layers on the cathode pointed out. The occurrence of cold arcs on refractory cathodes is discussed.

VIEWS on the NEWS

By REFLECTOR

AS my readers will be aware, the Malta Dockyard is being transferred from the Admiralty to C. H. Bailey & Co. and this has caused trouble among the dockyard workers. So far as I know there is no electrical significance in this, which makes a report in last Sunday's *Observer* a little cryptic. J. Halcro Ferguson, that paper's correspondent, writing from Valletta, reports an interview with a dockyard worker in the following terms:—

"'But surely, if the Navy is being cut down you are far better off with a commercial firm?' I suggested. Maybe, he said, but they'd be happier with Metropolitan-Vickers. 'Where do you get that idea?' broke in the R.E.M.E. sergeant, who had given me a lift to the docks. . . . 'It isn't my idea,' replied the man, 'it's what the General Workers' Union say.'"

* * *

I have previously commented on the excessive enthusiasm displayed in some first-aid competitions. At a recent one in Oxford, in which employees of the Southern Electricity Board took part, one "patient" was pretty severely handled. The *Oxford Times* says:—

"When trying to stop the blood flow from an imaginary head wound by applying pressure to an artery in the neck, they evidently pressed her windpipe instead. The 'patient,' a member of the Abingdon branch of the Casualties' Union, turned a deeper purple, and the doctor who was judging the competition had to intervene."

It seems to me that "casualties" really need a union—to protect them from restrictive practices oddly enough.

In another first-aid competition run by electricity supply people in Bristol the test was provided (says the *Somerset County Herald*) by an emergency through the supposed explosion of a gas geyser. Wasn't this rather unkind?

* * *

While the professions of law and medicine, for instance, are regarded with great esteem—and even a certain measure of awe in many quarters—professional engineers are still looked upon as some sort of superior mechanics. And yet the nature, extent and depth of their training and experience entitles them to claim a status not lower than that of lawyers and doctors. Indeed it was a lawyer (the Lord Chancellor) who, speaking at last week's I.E.E. dinner, said that the profession of electrical engineering was now being considered as "U" as literary scholarship and thus, by implication, as estimable as those other professions I have mentioned.

* * *

There was something slightly odd about the prosecution, at Rotherham last week, of the National Coal Board for emitting dark smoke from a chimney at one of its collieries. The summons was dismissed after both the prosecution and the defence had stated that the N.C.B. was doing its best to suppress smoke from its premises. The prosecution said (as reported by the *Manchester Guardian*) that the Board was "electrifying its furnaces throughout the area but the process seemed very slow." The defence said that the Board "was doing everything it could to substitute electrical equipment for the boilers at the 'fabulous' cost of £400,000." While setting this good example the Board is encouraging the use of raw coal elsewhere. Why does it not preach what it practises?

* * *

As I have referred to the proposed method of keeping sharks away from South African coastal resorts I feel bound to report the results of the first experiments, just completed. The idea was to set up electrical barriers across the St. Lucia Estuary in Northern Natal. The first tests have shown that the sharks react violently to electric shocks. The official report says:—

"Three sharks were netted some days ago and placed in a basin which had been dredged in the estuary. Before they were freed cork buoys were tied to their tails. An electric field was created across the mouth of the basin and the sharks were seen to react to this barrier. Dr. J. P. A. Lochner, who is in charge of the experiments, intends to see whether the repulsion of the electric barrier is stronger than the sharks' craving for food."

As the scheme is intended for the protection of bathers, the use of the word "food" has a gruesome ring.

* * *

From time to time interest is revived in the country's canals, either for commerce or for pleasure. Not much is said about propulsion or haulage methods; the general idea seems to be the use of oil-engine-driven boats. Half a century ago the *Electrical Review* (5th March, 1909) reported that:—

"The development of the electric haulage has made considerable progress on the French canals; the Société de Halage Electrique has lines extending 83 km along the Aire, Deule and other canals, where the traffic is very important, the up-stream traffic of the Sensée Canal in 1906 amounting to nearly 3½ million tons. The company has 30 Galliot-Denèfle tricycles in use, over a length of 25 km; the rest of the system is served by 60 four-wheeled tractors running on rails. The latter are really locomotives, and were designed by M. Chanay, director of the company. The total weight of each tractor is about 10 tons; it is driven by two tramway motors developing 20 h.p. at 550 volts, through double-reduction gear having a ratio of 144:1. The tractive force developed varies from 1,200 kg at 3 km per hour to 300 or 400 kg at 5 km per hour; the speed running light is at least 14 km per hour. The usual speed, hauling three or four boats, is 3 km per hour, with a consumption of 4 watts per ton-km. The cost of maintenance is extremely small."

INDUSTRIAL NEWS

Cable Makers' Federation

The Electric Cable Makers' Federation held its first annual meeting in London on 25th February when Mr. F. Waine, J.P., a director of British Insulated Callender's Cables, Ltd., and Mr. S. Geipel, chairman of Wm. Geipel, Ltd., were re-elected president and vice-president respectively.

The Federation was formed in January last year and has a membership of forty firms representing practically the whole of the country's cable-making industry. During the past year, among other matters, studies have been initiated into the possible effects upon the British cable-making industry of the European Common Market and the proposed Free Trade Area.

The Federation is in no way concerned with price-fixing or other related commercial activities. The present address of the Federation is Dickens House, 15, Took's Court, Chancery Lane, London, E.C.4, and the acting secretary is Mr. F. Harries.

Scottish Industry on Show

The third Scottish Industries Exhibition will be held at the Kelvin Hall, Glasgow, from 3rd to 19th September next. The exhibition is promoted by the Scottish Council (Development and Industry) and will be open each day, except Sunday, from 10 a.m. to 10 p.m.

All the available space has already been booked by more than two hundred exhibitors from one hundred industries; only goods manufactured in Scotland will be displayed. The electrical industry is represented by some thirty firms who will be showing equipment covering the whole range of the industry's output from generating plant to domestic appliances and from electronics to insulating materials and cables.

The two previous exhibitions held in 1949 and 1954 each attracted half a million visitors, and together resulted in £20 million of direct business.

Meter Certification

The Minister of Power has made the Meters (Periods of Certification) Order, 1959 (S.I. 1959, No. 272, H.M. Stationery Office, price 3d). This provides, in respect of electricity meters certified on or after 1st January, 1947, that certification shall cease to have effect after 15 years from the date of certification. It also specifies in a schedule periods in which the certification of meters dealt with before 1st January, 1947, ceases to have effect.

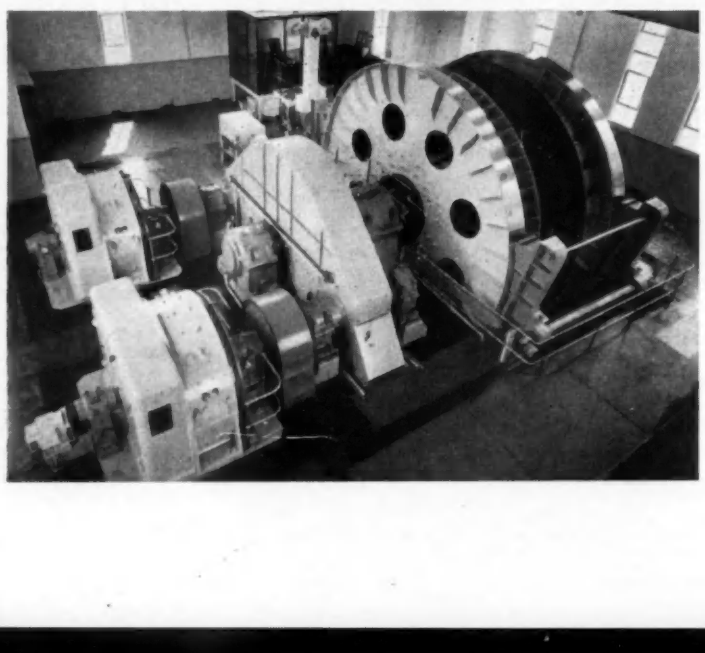
English Electric Scholarships

The second series of university scholarships, offered annually by the English Electric Co., Ltd., to school-leavers likely to qualify for senior posts in the engineering industry have now been awarded for 1959 to nineteen scholars from schools in various parts of the country. The scholarships are worth £450 a year, and cover a three-year course at a university in the United Kingdom, to study for an honours degree in engineering, applied science, mathematics or any subject relevant to advanced technology.

Winder for South African Gold Mine

A four-rope tower-mounted friction winder, the first of its type to be erected in South Africa, has recently been installed at the No. 5 ore shaft of the West Driefontein Gold Mining Co., Ltd. It was designed and manufactured at the Erith Works of the General Electric Co., Ltd., and the electrical equipment was manufactured and supplied by the Witton, Birmingham, works of the G.E.C. The winder was put into service early this year. Driven by two d.c. motors, each of 2,050 h.p., with forced ventilation, it is capable of raising ore, in balanced skips holding 14 tons each, at the rate of 330 tons an hour from a depth of 5,400ft.

G.E.C. friction winder installed at the West Driefontein Gold Mining Co.'s No. 5 shaft



Power Plant for Los Angeles

A *Reuter* message from Los Angeles says that the city authorities have placed an order for two 200 MW generating sets, at the price of $9·3 million (about £3·3 million), with Brown Boveri, Switzerland. This was the lowest tender, the next three being from the English Electric Co. ($9·6 million), Metropolitan-Vickers ($11·2 million) and C. A. Parsons & Co. ($11·5 million). The lowest American offer was that of the General Electric at $14·8 million.

Builders' Guide

The 1959 edition of "Sell's Building Trades List" contains over 40,000 names (arranged alphabetically), addresses and telephone numbers of firms in Great Britain and Ireland engaged in the building industry, and those who provide services relevant to the building trades. The sections dealing with contractors' plant, quarry products and plastics have been revised and enlarged and the trade names and brands section has been increased. A "Review of New Products" has been introduced and there is a list of over 600 associations, federations and other organisations concerned with the building trade. The directory is published by Business Dictionaries, Ltd., St. Dunstans House, 133-137, Fetter Lane, Fleet Street, London, E.C.4, price 40s.

Wholesale Prices in 1958

The *Board of Trade Journal* shows that wholesale prices of raw materials and manufactured goods were more stable last year than in 1957. The falls which occurred throughout 1957 in imported materials prices from the peaks reached in the winter of 1956-57 continued into 1958 and on average last year prices of basic materials used in the manufacturing industry were 7·8 per cent lower than in 1957. This fall was however offset to some extent by a rise of 4·6 per cent in the cost of fuel, giving an overall fall of 6 per cent.

Materials and fuel used in the electrical machinery industry fell by only 0·4 per cent. The indices fell steadily in the first five months of the year

with the falling prices of non-ferrous metals and a decrease in iron and steel prices at the end of March. The recovery in some non-ferrous metal prices, particularly copper and tin, in the latter half of the year caused the indices to turn upwards again so that they finished the year at roughly the same level as at the end of 1957.

After falling slightly in the early months of the year, the index for all manufactured products (home market sales) remained stable until October and then started to move upwards again. The wholesale price index for domestic electrical appliances (1954=100) was 104·1 last year compared with 102·4 in 1957 and 101·4 in 1956. The indices for individual appliances last year, with the 1957 figure in parentheses, were vacuum cleaners 108·4 (106·1); cookers 114·4 (111·8); fires 103·5 (105·1); refrigerators 97·1 (96·1); washing machines 100·6 (98·5).

British Railways Derby Works

As part of its modernisation programme, British Railways (London Midland Region) has begun a major reorganisation of the steam and electrical power plant in the locomotive and carriage and wagon works at Derby. A new boiler house and turbine room is to be built in the carriage and wagon works to house three new boilers and two new turbo-alternators. Similar plant will be installed in the locomotive works. A substation is being built and several miles of new electric cable laid. Alterations will be largely completed early in 1960.

Essay Competition

Research, published by Butterworths Scientific Publications, is sponsoring the Waverley Gold Medal Essay Competition which is designed to encourage and promote improved and more effective reports of scientific and technical work. Particulars can be obtained from the Editor of *Research*, 4-5, Bell Yard, London, W.C.2, and entries must be submitted by 31st July next.

Cable Factory Relighted

A new floodlighting installation at Ripaults electric cable factory in Enfield marks the completion of a five-year relighting programme covering the whole factory. The company standardised on A.E.I. Lamp & Lighting Co.'s F.1160 5ft single-lamp fluorescent fittings for all departments in the main factory area and a total of over 600 of these fittings has been used, with "Mazda" warm white fluorescent lamps, in the cable making, harness, engineering, cutting up, heavy cable, tinsel and various other ancillary departments. In most cases individually mounted fittings incorporating open-ended stove-enamelled trough reflectors with upward light slots have been used mounted at heights ranging from 8ft 9in to 9ft 6in and spaced approximately 7ft between centres of each fitting within rows, the spacing of rows varying between 10ft and 11ft. An average illumination level of 22 lumens/sq ft has been achieved throughout the factory.

Braiding department in Ripaults electric cable factory, Enfield, with A.E.I. Lamp & Lighting Co. fluorescent fittings

The facade, lawns and flower beds in front of the works have been floodlighted and the night-time appearance has also been enhanced by the use of a number of "Mazda" 15 W pygmy sign colour-sprayed lamps in the fir trees on the front lawn. Sixteen A.E.I. M.23 500 W wide angle floodlights are used for the main installation, a single M.26 1,000 W tungsten floodlight to light the gatekeeper's office, and the M.20 narrow beam floodlight, housing a "Mazda" B.I. 500 W projector lamp, is used to pick out the centre tower and flagpole. The forecourt car park is lighted by two A.E.I. type M.9 floodlights mounted at a height of 17ft on a concrete standard. All the lighting equipment has been installed by the company's own electrical staff working under the general supervision of the chief engineer, Mr. G. W. Robinson.

Swiss Import Exhibition

The third Swiss Import Exhibition (ZUSPA), to be held at Zurich from 22nd to 31st May, 1959, will this year be devoted to consumer goods. Last year capital and technical equipment was shown.

Only Swiss firms may exhibit, but all the goods shown must be imported. As foreign firms are excluded from most of the Swiss trade fairs this exhibition offers a good opportunity to British manufacturers (through their agents) to bring their products to the attention of the Swiss public.

Batti-Wallahs' Society

The largest gathering for some months past attended last week's luncheon of the Batti-Wallahs' Society at which Sir Christopher Hinton, chairman of the Central Electricity Generating Board, was to have been the guest speaker. Unfortunately Sir Christopher had succumbed to influenza and at the last moment Lord Coleraine (chairman of the Atomic Power Constructions, Ltd., and other companies) kindly agreed to fill the breech, and although he averred that he had no intention of deputising for Sir Christopher, particularly on atomic energy matters, he nevertheless entertained his listeners with an address which was a happy blend of humour and serious observation, in which he drew analogies between things nautical and political. Mr. H. H. Spencer (president) introduced Lord Coleraine, and Sir John Hacking proposed a vote of thanks. Mr. T. C. F. Bigland (the "Mate") announced that the next luncheon would be held on Wednesday, 25th March, when the guest speaker would be Sir John Lang. Members are reminded that the ladies' night will be held on 20th March at the Connaught Rooms.

Synthetic Rubber Cable in a Ship

The 11,000-ton Royal Mail Lines motor vessel *Loch Loyal* has been wired exclusively with butyl rubber insulated cables, selected for their low water absorption characteristic and oil, solvent, fire and low temperature resistant qualities. The 250 V and 660 V cable for all the generating, lighting and electrical circuits was supplied by British Insulated Callender's Cables, Ltd., and the installation was carried out by Harland & Wolff, Ltd., Belfast.

Valve Data

The 1959 edition of "Abridged Valve Data" has been received from the Technical Publications Department of the English Electric Valve Co., Ltd., Chelmsford, Essex. This quick reference brochure covers all English Electric valves.

Industrial Films

A new edition of its "Films for Industry" catalogue has been issued by the Central Office of Information, Hercules Road, Westminster Bridge Road, London, S.E.1. The catalogue now contains 612 films and 52 filmstrips classified under trade headings

The winning design in the recent competition organised by the Electrical Sign Manufacturers' Association

and there is also an alphabetical list of titles. The films and film strips are intended for training purposes and as an aid to promotion of production efficiency through new or improved technical methods, processes and materials.

Illuminated Sign Design Competition

On Monday next, at the Savoy Hotel, London, the prizes in the recent illuminated sign design competition, sponsored by the Electrical Sign Manufacturers' Association, will be presented to the winners by Mr. Henry Brooke, P.C., M.P. The winner of the first prize (£150) is Mr. H. Kirotar, London, S.E.4, whose design is shown in the above picture.

Scottish Dairy Show

The electricity stand, presented jointly by the South of Scotland Electricity Board and the Electrical Development Association, at the recent Scottish Dairy Show consisted of a comprehensive display of all the latest types of electrical equipment for the farmer and his wife. A large portion of the stand was devoted to electric crop drying, and various methods of both grain and grass drying were demonstrated. Another section of the exhibit was devoted to dairy water heating and steam raising equipment, while the farmer's wife was catered for by a display of electrical appliances for the house and kitchen.

Diesel-Electric Locomotive Orders

Laurence, Scott & Electromotors, Ltd., inform us that they are co-operating with Crompton Parkinson, Ltd., in the manufacture of the electrical equipment for the 137 diesel-electric main-line locomotives to the order of the British Transport Commission, reference to which was made in our last issue.

Large Transformers for Tasmania

Among the many large high-voltage transformers built by the Hackbridge & Hewittic Electric Co., three 100 MVA, 220/110 kV units being supplied to the Hydro-Electric Commission of Tasmania are of particular interest since they are the largest naturally-cooled transformers built by the company. They are to be installed in the Chapel Street substation at Hobart to handle the power generated by Wayatinah "A," Wayatinah "B" and Catagunya hydro-electric stations. The windings are star-connected with the neutral earthed, and a 25 MVA delta-connected tertiary is included. The three-limbed cores are of cold rolled steel. Cooling is by means of two banks of radiators placed one at each end of the transformer. The specified impulse test levels were 900 kV for the 220 kV side and 550 kV for the 110 kV side and impulse voltage type tests at these levels were satisfactorily carried out.

Works Visit

During their tour of British industry members of a Turkish industrial mission visited the Liverpool and Netherton works of the English Electric Co., Ltd., and saw plant being manufactured, of the type which the company has supplied for the Hirfanli hydro-electric project in Turkey. At Liverpool works they also saw equipment for the new Turkish broadcasting station being supplied to the English Electric associate company, Marconi's Wireless Telegraph Co., who are the contractors for the main transmitter.

Plant for Kariba

The first of the six 111,111 kVA, 167 r.p.m. generators for the Kariba hydro-electric power station in Rhodesia has recently completed full-scale tests at the works of the Metropolitan-Vickers Electrical Co., Ltd., Manchester. These tests were carried out for the electrical and mechanical consultants, Messrs. Merz & McLellan.

For the Kariba scheme, Ferranti, Ltd., have received an order valued at approximately £47,000 for summation metering equipment comprising precision grade integrating meters, electro-mechanical summators, printometer demand recorders and suites of metering cubicles. These equipments will be used to meter the six 100 MW generating sets at Kariba power station and also the supplies to the transforming stations at Kitwe, Norton, Salisbury, Lusaka, Sherwood and Bulawayo.

Metropolitan - Vickers 111,111 kVA generator for Kariba in the final stages of assembly for testing at the company's Manchester works

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 13th February is deemed to be 194s.

The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 13th February is 179·1 (1949=100) and 115·5 (1954=100); both figures are provisional. For turbo-generating and allied plant: Materials used in mechanical engineering industries 186·4 (1949=100) and 124·1 (1954=100), blast furnaces and iron and steel melting and rolling (40 and 41) 190·7 (1949=100) and other steel goods, excluding tubes (311 and 312) 129·9 (1954=100). The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 17th February) is 47¾d per lb.

Brookhirst Igranic Sales Conference

The first sales conference of the newly combined Brookhirst Igranic organisation was held in Bedford on 25th and 26th February. Area managers and technical experts from all parts of the country were present. The opening session was attended by Sir Charles Westlake, chairman of Brookhirst Igranic, and of its parent company, Metal Industries, Ltd. Others present included Mr. H. O. Houchen, managing director of the

company, Mr. J. O. Knowles, a member of the board, Mr. G. H. M. Houston, director of sales and contracts, Mr. T. D. Turner, director of production, Mr. D. W. Kent, general manager, Igranic, and Mr. R. H. Mercer, general manager, Brookhirst. Mr. A. W. Page, sales manager, presided.

Proposed Information Service

Mortimer, Gall & Co., Ltd., 115-117, Cannon Street, London, E.C.4, tell us that they propose to set up an information service "covering all aspects of domestic, commercial and industrial consumer electrical equipment and appliances." It will be available to architects, building owners and commercial and industrial interests. Manufacturers and suppliers are asked to send catalogues, information sheets and price lists to the company marked "for the attention of Mr. Anderson."

Monopolies Commission Report

The Board of Trade's tenth annual report on the work of the Monopolies Commission (H.M.S.O., price 9d) records that the Commission have before them only one reference of electrical interest, namely the "supply of electrical equipment for mechanically propelled land vehicles." Suggestions received during 1958 for subjects to be referred to the Commission included carbon rods for primary batteries, dry shavers, and sole agency and exclusive arrangements generally.

With regard to earlier reports of the Commission, the Board of Trade last year informed the Rubber and Thermoplastic Cable Makers' Association that they had no objection to the introduction of a simplified procedure for the computation of minimum prices but that they might wish to review the matter at some future date.

H.R.C. Fuse Discrimination

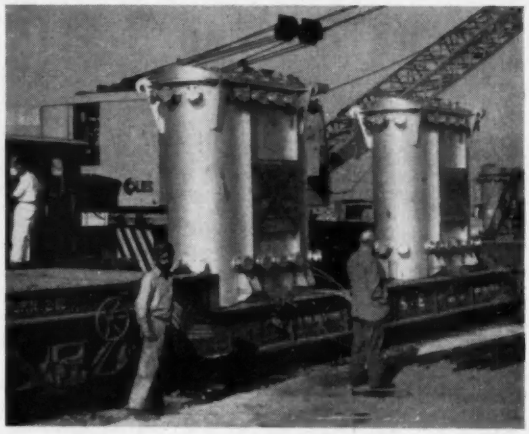
In our issue of 20th February we published a report on the discussion of the paper by Mr. E. Jacks dealing with "Discrimination between H.R.C. Fuses." In this we referred to the remarks made by Mr. J. R. Anderson, and said that he was with Crompton Parkinson, Ltd. Mr. Anderson is commercial officer, Birmingham and District Sub-Area, Midlands Electricity Board.

Motor Control Pamphlet

The latest pamphlet, "Motor Control Centres," received from the Igranic Electric Co., Ltd., of Bedford, describes briefly the company's extensible motor control centres containing withdrawable panels. Panel construction and wiring is dealt with, and details are given of the basic control units and block contactors incorporated.

Street Lighting Conference

Over 100 North Eastern provincial experts in municipal engineering, surveying and town planning attended a one-day street lighting conference and exhibition at Newcastle on 4th March. Invited by the Association of Public Lighting Engineers and the British Lighting Council, they heard Mr. J. T. Grundy (chief lighting sales engineer of Siemens Edison Swan, Ltd.) and Mr. J. W. Howell (regional engineer of the British Lighting Council) talk on the planning of street lighting and equipment available today.



Two of five 10 MVA transformers for the main substation which will supply power to the steelworks being built by a British consortium at Durgapur in India. The transformers, delivered by the English Electric Co., Ltd., are being off-loaded at site under supervision of the company's site engineer

Educational

A six-weeks' full-time course on "Nuclear Reactor Technology" commences on 20th April at the Bradford Institute of Technology. The fee for the course is £30 and particulars can be obtained from the head of the Department of Electrical Engineering.

Price Reductions

Prices of part of the Ferranti range of television cathode-ray tubes have now been reduced.

Ferranti, Ltd., have also announced an average price reduction of approximately 23 per cent on part of their range of silicon rectifiers.

M.K. Electric, Ltd., has reduced all list prices in its range of cooker control units by about 10 per cent with effect from 1st March. These new prices are published in leaflet 246 which describes the complete range and includes coloured illustrations.

Following on the recent reduction in the price of pure magnesium, Magnesium Elektron, Ltd., the sole producers in this country, announce that the price of some of their magnesium alloy ingots has been reduced, with effect from 15th February last.

Trade Announcements

Alfred Ellison, Ltd., announce the appointment of Mr. J. M. M. Winkelman as sales and technical representative for Ellison grey iron castings in London and the Home Counties.

Metal Industries, Ltd., announces that it has formed a new company, **Brookhirst Igranic (Europe), Ltd.,** with headquarters in Brussels (62, rue Joseph II), to co-ordinate the European activities of its electrical subsidiary, Brookhirst Igranic, Ltd. Directors of the new company are Messrs. J. Black (chairman), H. Derboven (deputy chairman), R. H. Frings and H. O. Houchen.

The **Yale & Towne Manufacturing Co.** has opened a new service depot at Wilson Place, Nerston Industrial Estate, East Kilbride, Lanarkshire (telephone: East Kilbride 20241).

The **Rubery Owen Group** has formed a RowenArc Division to manufacture under licence in Britain an arc-welding equipment developed by the Westinghouse Electric Corporation of Buffalo, New York, known in America as West-Ing-Arc. Mr. F. Collins is the chief engineer of the new division, Mr. C. J. Kemp is process engineer, and Mr. N. Schlater is production manager.

Recent sales staff appointments by **Ottermill Switchgear, Ltd.,** include Mr. I. T. B. McCallum, "Glenview," Gartmore, Sterling (telephone: Aberfoyle 363), who will be responsible for sales in Scotland; and Mr. R. Oakley, "Red Gables," 43, Weeping Cross, Stafford (telephone: Milford 235), who takes over the Midlands area. Consequent upon these two appointments the company has made changes in sales representation in other counties.

Hawnt & Co., Ltd., have moved to 112-114, Pritchett Street, Birmingham, 6 (telephone: Aston Cross 4301-7).

Waveforms, Ltd., has opened a new factory for the production of electronic instruments at Wallisdown Road, Bournemouth.

Sterling Moulding Materials, Ltd., manufacturers of thermosetting moulding powders, have taken over from Canusa, Ltd., 14, Buckingham Street, London, W.C.2, its continuous extrution compounding process for the production of phenolic moulding powders. The original Canusa unit has been transferred to the Sterling Cheshire factory and will operate in conjunction with new plant.

GENERATION and DEVELOPMENT

Chapelcross Nuclear Power Station

The first reactor at the United Kingdom Atomic Energy Authority's Chapelcross station went "critical" last November and it has now completed its testing and commissioning period. Steam has been produced for some time but hitherto it has been passed to a dump condenser instead of to one of the four 23 MW turbines. Like Calder Hall, Chapelcross ultimately will have an installed generating capacity of 184 MW and, taking into account the station auxiliaries, it will feed about 140 MW into the national grid. The construction of the station is being carried out under the control of Messrs. Merz & McLellan, acting as agents for the Atomic Energy Authority's Industrial Group. This is the first occasion on which a private firm has been employed in this way by the Authority on a major project.

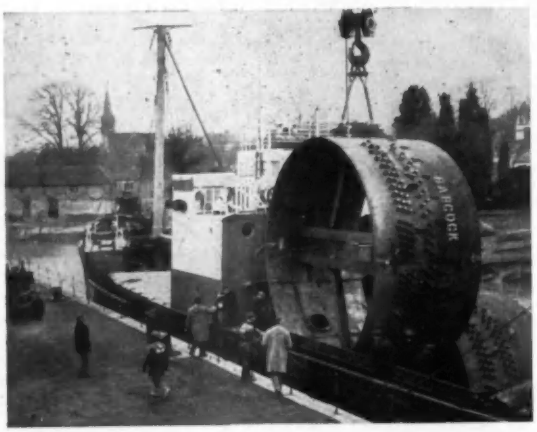
North Eastern Tariffs

The North Eastern Electricity Board has published separate leaflets setting out the new tariffs for industrial, commercial and domestic premises, farms and places of worship. Details of the tariffs, which will take effect from 1st April, were given in the *Electrical Review* of 16th January, page 128.

Plant for Hinkley Point

Long derelict, the port at Combwich, on the River Parret seven miles downstream from Bridgwater, has been rebuilt at a cost of £250,000 to handle the heavy atomic plant required for the Hinkley Point nuclear power station. This plant, totalling over 30,000 tons, can thus be shipped by sea instead of being transported over the main trunk roads from the north. The station is being constructed for the Central Electricity Generating Board by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group, and the accompanying photograph shows the first of 120 sections, each 23ft in diameter and weighing over 40 tons, for the site fabrication of twelve 90ft-high steam-raising units being unloaded from the M.V. *Holdernith* on arrival from the Dalmuir Works of Babcock & Wilcox.

Section of steam-raising unit for Hinkley Point being unloaded at Combwich, Somerset



All-Electric Maisonnettes

Hamilton Town Council has approved the construction of 32 all-electric maisonnettes in the Udston-Hillhouse scheme at a cost of £63,000. They will be provided with electric floor heating installations.

Smoke Control

A leaflet, "Smoke is Your Enemy," prepared by the Ministry of Housing and Local Government and the Central Office of Information, describes the harm caused by smoke and explains how domestic smoke, which causes half the trouble, can be brought under control in densely populated areas. The leaflet also discusses the procedure for creating a smoke control area.

More than 130 local authorities in England and Wales have decided to use their powers under the Clean Air Act to make orders creating smoke control areas, 75 orders have been confirmed, of which 33 are in operation, and proposals for a further 170 areas are in the preliminary stages.

Cheaper Off-Peak Rates

As briefly reported last week, the Eastern Electricity Board has announced a scheme to encourage greater use of electricity during off-peak hours. Consumers will be offered the choice of three periods during which they can have power. The first rate will be available between the hours of 10 p.m. and 7 a.m. at 0·78d/kWh; on the second rate, between 7 p.m. and 7.30 a.m., the cost will be 0·8d; and the third rate, which applies between 1 p.m. and 4 p.m. and between 7 a.m. and 7.30 a.m., will be 0·85d. The only fixed charge that will have to be paid by the consumer will be 13s a quarter. The chief commercial officer to the Board, Mr. R. H. M. Barkham, said that the new tariff would be particularly suitable for storage heating, such as floor warming, block thermal heating and storage water heating. He anticipated that the rate which offered two periods in the 24 hours during which reduced-price electricity could be used would become very popular. Certain concessions were also being made in the maximum demand tariff used by industrial concerns and other large users, the running charge being reduced with some increase in the demand charge. This "tilting" of the charges would encourage consumers to use electricity over a longer period each day, Mr. Barkham said. A reduction in the charge for off-peak supplies under the night and day rates was another variation which was calculated to encourage the use of electricity outside peak periods.

Scottish Inquiry

A proposed Order for pollution control over the tidal waters of the River Forth, if operated fully, could cost the South of Scotland Electricity Board £1,750,000 for the 15 months' delay in operating the new Kincardine-on-Forth power station. Mr. A. H. Marsh, generation (construction) engineer to the Board, said this on 26th February during an inquiry into the draft Order. He gave evidence for the Board on the possible effect on fish of the discharge of hot water from the cooling system. The station, he said, would eventually supply one-third of the electricity for the South of Scotland Board area, and if full operation was delayed, electricity might have to be bought from England. Besides the South of Scotland Board, the objectors to the Order include the National Coal Board and the Fife County Council.

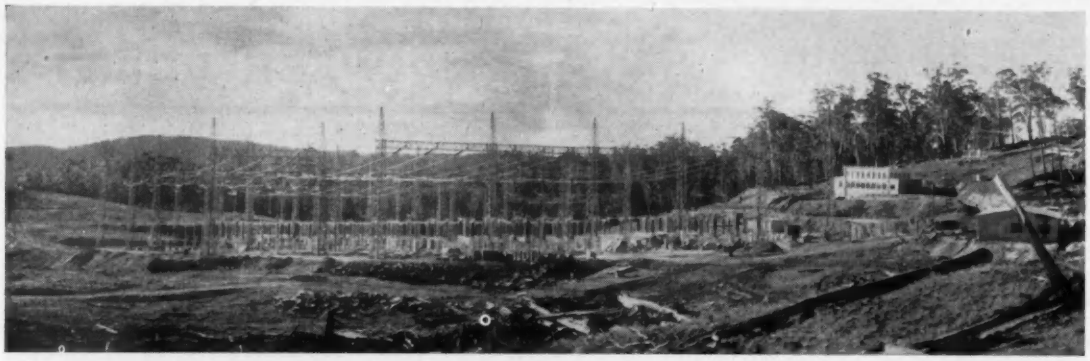
Planning Committee Approves Sizewell Site

Although it accepted the plan of the Central Electricity Generating Board to build a nuclear power station on a 234-acre site at Sizewell "with regret," the East Suffolk County Planning Committee last week decided to recommend the County Council to approve the proposal, feeling that of all the sites in mind this was the "least objectionable."

OVERSEAS

Lord Citrine in New Zealand

The January issue of *Live Lines* (the official journal of the Electrical Supply Authorities' Association of New Zealand) devotes a great deal of

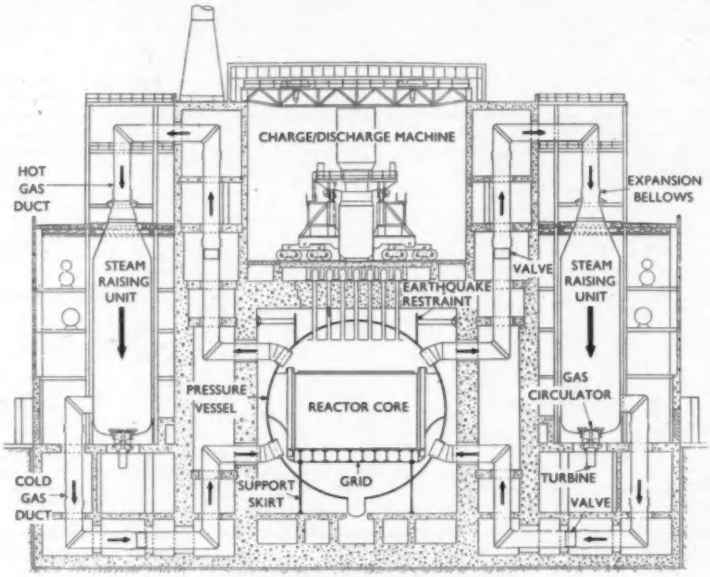


The Upper Tumut switching station, where power from the Snowy Mountains T1 station—and eventually from the T2 station—will be transmitted at 330 kV to New South Wales and Victoria. The three-storey building houses the Upper Tumut Group Control Centre where the entire electrical and hydraulic works associated with the Upper Tumut group of projects will be controlled and where the overall load dispatching functions of the whole Snowy system of power stations will be carried out. The first two 80 MW turbo-generators at the T1 station are due to be brought into operation on 19th March

space to addresses given by Lord Citrine (a member of the Electricity Council and the U.K. Atomic Energy Authority) during his recent visit to New Zealand.

Lord Citrine was asked many questions by electricity supply engineers who were particularly interested in his views on the future of nuclear power. He explained the circumstances which forced Great Britain to embark upon a programme of nuclear power station construction; he thought that New Zealand should first develop its available water power resources before looking for new methods of electricity production. Lord Citrine said he had no doubt that nuclear energy was the future source of electricity, although he expressed doubts about the development of small reactors for industrial power purposes in the immediate future. In spite of the predictions of some economists, or pessimists, he did not think that the "saturation" point for electricity could be foreseen.

Lord Citrine answered a number of questions on the production and retail distribution of electricity in Great Britain.



Japanese Nuclear Power Station

Reactor designed by the G.E.C.–Simon Carves Group for the 150 MW nuclear power station at Tokai Mura, Japan. As announced last week the Japan Atomic Power Co. is engaged in exclusive negotiations with the G.E.C. on the contract for this station. The single gas-cooled graphite-moderated reactor is similar to the two being built at Hunterston ("Electrical Review," 26th April, 1957), but it has four instead of eight heat exchangers and the fuel charge/discharge machine operates from the top and not the bottom of the core. Special structural and control features have been incorporated to ensure safety during earthquakes. The number and capacity of the generating sets, and whether these will be built in this country or Japan, has not yet been revealed

German Nuclear Power Station

The German Study Association for nuclear power stations formed by six large electricity supply concerns has given orders for preparatory work for an atomic power station with a capacity of between 100 and 150 MW to be built at Hanover. The preparatory work is expected to take two years and cost 12 million marks (about £1 million). Two-thirds of the cost will be paid by the West German Ministry of Atomic Affairs.—*Reuter* (Hamburg).

Nigerian Notes

The January/March issue of the official *Nigeria Trade Journal* states that the Electricity Corporation of Nigeria has set aside £380,000 for the extension of supply to Umuahia, Ilorin, Ogbomosho and Kumba. It is also to introduce a number of self-contained mobile diesel generating sets in rural areas where the normal static plant would be uneconomic.

The Corporation is acquiring, for £97,000, the Owerri power station of the Shell-BP concern. It intends to build a 15 MW gas turbine generating station near Afam, as near as possible to the Port Harcourt-Aba 66 kV transmission line now being erected.

The Northern Regional Government is allocating £400,000 for the installation of electricity supply at Gusau, Bida, Lokoja, Funtua, Minna, Makurdi and Offa. In the Western Region £300,000 is to be devoted to the supply of electricity in Ijebu Province. Electricity is also to be provided for Ondo, Idanre, Akure, Owo, Ikere, Ado-Ekiti and Ikare.

During the first three quarters of 1958 the imports of electrical machinery and apparatus into Nigeria were valued at £4,242,000, i.e. 3·5 per cent of total imports. In the corresponding period of 1957 the total was £3,986,000 (3·7 per cent).

DOMESTIC ELECTRICAL EQUIPMENT

WASH BOILERS

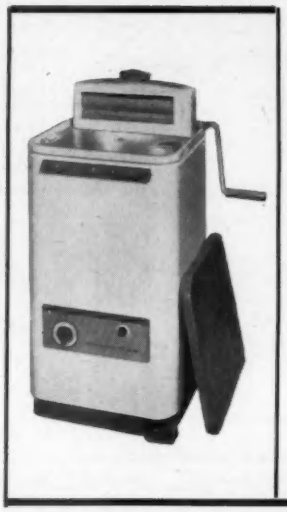
PRESENT-DAY electric wash boilers are designed to give many years of service and the latest cabinet models, stove enamelled in various colours, blend well with modern kitchen equipment. This does not mean, of course, that the galvanised round types have lost their popularity; in fact many manufacturers still continue to list one or more models in their range.

An indication of the advance that is being made in wash boiler design is given in the two latest additions to the Burco range, models "Three-Ten" and "305." Both are fitted with an electric emptying pump, a feature claimed to be hitherto unknown on a wash boiler, and, in addition, the "Three-Ten" is fitted with a wringer and, as an optional extra, a manually operated agitator unit.

Most standard wash boilers range in size from 8 to 10 gal and are capable of dealing with about 8 lb dry weight of clothes at one time. The electrical loading is usually in the region of 3 kW and the time to heat 10 gal of water from cold (55 deg F) to boiling is approximately an hour and a half. Most models are controlled by either rotary three-heat switches or foot-kick switches, whilst some are push-button operated. An automatic cut-out device which safeguards the boiler should it be switched on when empty or left to boil dry is an optional extra with many makes.

The smaller wash boilers, suitable for the flat dweller or for use in confined spaces, have proved to be quite popular and the latest addition to this category is the "Mirro-Matic," a 5 gal model with a loading of 2 kW which has just been placed on the market by Mirroware.

Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
BRADLEY & CO., LTD., Albion Works, Bilston, Staffs.	"Beldray" 329	Round	—	4½ gal	No	No	2 kW	Direct from plug. Cut-out
BRUNLEC APPLIANCES, LTD., Junction Mills, Junction Street, Burnley.	Boiler/Wringer "XLW"	Cabinet	29½ × 16 × 17½	10 gal	Yes (plus 9s 3d purchase tax)	Optional extra	3 kW	3-heat push-button switch
	"XL2"	Cabinet	29½ × 16 × 17½	10 gal	No	No	3 kW	3-heat push-button switch
	"560"	Round	27 × 19 diameter	10 gal	No	No	3 kW	3-heat foot-press switch
	"XL"	Cabinet	28 × 16½ × 16¼	10 gal	No	No	3 kW	Standard cut-out
BURCO, LTD., Rose Grove, Burnley.	"Baby Burco" 761.S	Round	19⅜ × 18 diameter	5 gal	No	No	2 kW	3-heat d.p. switch
	"Baby Burco" E.761.S	Round	19⅜ × 16 diameter	5 gal	No	No	2 kW	3-heat d.p. switch
	350 F	Round	26½ × 16½ diameter	8 gal	No	No	2·625 kW	3-heat foot-press switches
	375 AS	Round	28 × 17⅞ diameter	10 gal	No	Agitator lid unit available £2 10 6 extra	3 kW	3-heat rotary switch
	E.300 AS	Cabinet	28⅜ × 16⅜ × 19	10 gal	No	No	3 kW	3-heat d.p. switch
	763 DX	Round	31⅜ × 19⅜ diameter	16 gal	No	No	4·5 kW	3-heat rotary switch
	305	Cabinet	29 × 17¼ × 16¾	10 gal	No	No	3 kW	2-heat d.p. rotary switch
	310	Cabinet	29 × 17¼ × 16½	10 gal	Yes	Agitator lid unit available 14s 6d extra	3 kW	2-heat d.p. rotary switch
CHALFONT ELECTRICAL PRODUCTS, LTD., Tyrrell Street, Leicester.	"Popular"	Round	12 × 16 diameter	4½ gal	No	No	2 kW	Direct from plug
CO-OPERATIVE WHOLESALE SOCIETY, LTD., Hall Street, Dudley, Worcs.	"Invincible"	Round	12 × 16 diameter	4 gal	No	No	1½ kW	Direct from plug
DARLASTON GALVANISED HOLLOWARE CO., LTD., Holyhead Road, Wednesbury, Staffs.	"Red Label"	Round	13 × 16 diameter	4½ gal	No	No	2 kW	Direct from plug. Cut-out
	"Universal"	Round	15 × 15 diameter	4½ gal	No	No	2 kW	Direct from plug. Cut-out



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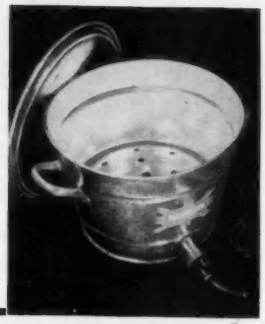

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1. *Burco model "Three-Ten" cabinet wash boiler with wringer*
2. *Darlaston "Red Label" 4½ gal boiler*
3. *Bradley "Beldray" 329 4½ gal boiler*

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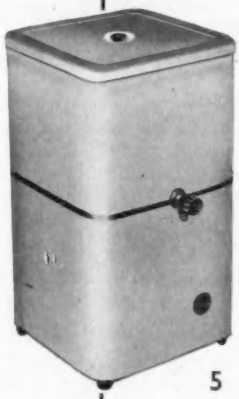

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4. *C.W.S. "Invincible" 4 gal boiler*
5. *Brunlec "XL" cabinet wash boiler*
6. *Chalfont "Popular" 4½ gal boiler*

6

Exterior Finish	Tub Finish	Price
Galvanised	Galvanised	£4 0 0
Cream or white vitreous enamel	Mottled vitreous enamel	£20 10 0
Cream or white vitreous enamel	Mottled vitreous enamel	£12 5 0
Galvanised	Tinned copper	£9 7 6
Cream or white vitreous enamel	Mottled vitreous enamel	£10 10 0
Anodised aluminium	Anodised aluminium	£6 19 6
Cream enamel, with maroon or eau-de-nil fittings	Anodised aluminium	£7 7 0
Galvanised	Tinned copper	£9 7 6
Galvanised	Tinned copper	£9 15 0
White or cream with 2 tones of blue	Anodised aluminium	£12 12 0
Galvanised	Tinned copper	£19 15 0
White or cream with Brixham blue	Anodised aluminium	£18 3 6
White or cream with Brixham blue	Tinned copper	£29 2 6
Galvanised	Galvanised	£3 7 6
Galvanised	Galvanised	£3 10 0
Galvanised or stoved enamel	Galvanised	£3 19 6
Anodised aluminium or stoved enamel	Anodised aluminium	£5 12 0

7

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9

Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
EASICLENE PORCELAIN-ENAMEL (1938), LTD., Lord Street, Wolverhampton.	"Easiclene"	Cabinet	28×16×16	10 gal	No	No	3 kW	3-heat switch
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	DE4763	Round	27×18 diameter	9½ gal	No	No	3 kW	2 s.p. switches
	DE4764	Round	27×18 diameter	9½ gal	No	No	3 kW	2 d.p. switches
	DE4765 and DE4765C	Round	27×18 diameter	9½ gal	No	No	3 kW	2 d.p. switches and cut-out (a.c. only)
	DE4759	Cabinet	28×16⅝×16⅝	9½ gal	No	No	3 kW	2 d.p. switches
	DE4760	Cabinet	28×16⅝×16⅝	9½ gal	No	No	3 kW	2 d.p. switches and cut-out (a.c. only)
L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, Kingsway, London, W.C.2.	"Dinky"	Round	12×10½	2½ gal	No	No	1½ kW	—
LAMB, HINGLEY & CO., LTD., Lye, Stourbridge, Worcs.	"Apex" 436	Round	12½×15 diameter	4½ gal	No	No	2 kW	Direct from plug
	"Apex" 438	Round	25×17 diameter	10 gal	No	No	3 kW	On/off press-button switches
	"Apex" 440	Round	25×17 diameter	10 gal	No	No	3 kW	"Simmerstat" control
R. & A. MAIN, LTD. (Electrical Division), 48, Grosvenor Gardens, London, S.W.1.	Main "55 Plus"	Cabinet	33×15½×18	10 gal	Yes (plus 9s 5d purchase tax)	Optional extra	3 kW	Push-button switches, twin indicator lights and cut-out
	Main "55"	Cabinet	29×15½×18	10 gal	No	No	3 kW	Push-button switches, twin indicator lights and cut-out
MASTERMET PRODUCTS, LTD., Elmgrove Road, Harrow, Middlesex.	"Mini-Wash"	Round	21½×15½ diameter	5 gal	No	No	2 kW	3-way switch
MIRROWARE CO., LTD., 349-351, Edgware Road, London, W.2.	"Mirro-Matic" EB.10	Round	18×12 diameter	5 gal	No	No	2 kW	3-heat rotary switch
NORTHERN INDUSTRIES, Snow Hill, Manchester, 4.	"Little Treasure"	Round	15½×10½ diameter	4½ gal	No	No	2 kW	Direct from plug

10

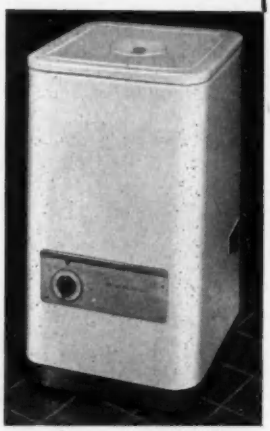
11

Exterior Finish	Tub Finish	Price
White, cream or eau-de-nil	Vitreous enamel	£15 15 0
Galvanised	Tinned	£9 15 0
Galvanised	Tinned	£10 3 0
Galvanised (DE4765) and honeysuckle enamelled (DE4765C)	Tinned	£11 4 0 (DE4765) £12 5 0 (DE4765C)
White or honeysuckle enamelled	Tinned	£15 6 0
White or honeysuckle enamelled	Tinned	£16 7 0
Frosted aluminium	—	£4 7 6
Galvanised	Galvanised	£3 16 3
Galvanised	Galvanised	£8 0 0
Galvanised	Galvanised	£8 15 0
Cream vitreous enamel	Grey mottled vitreous enamel	£23 19 5
Cream vitreous enamel	Grey mottled vitreous enamel	£15 17 6
Stove enamelled	Anodised aluminium	£9 9 0
Stove enamelled white with red, blue or yellow	Aluminium	£7 7 0
Galvanised	Galvanised	£3 5 0

12

13

7. *Main "55 Plus" cabinet boiler*
8. *Easiclene 10 gal cabinet wash boiler*
9. *G.E.C. cabinet wash boiler*
10. *Mirroware "Mirro-Matic" 5 gal wash boiler*
11. *Hawkins "Dinky" boiler*
12. *Lamb, Hingley "Apex" 438 10 gal model*
13. *G.E.C. round type wash boiler*
14. *Burco model "305" wash boiler*



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Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
RADIATION, LTD. (Electrical Division), 255, North Circular Road, London, N.W.10.	"Jackson" 908	Cabinet	30½ × 17½ × 13	10 gal	No	No	3 kW	3-heat s.p. rotary switch
	"Jackson" 909	Cabinet	30½ × 17½ × 13	10 gal	No	No	3 kW	2 d.p. switches and cut-out
SAMUEL SIMISTER & CO., LTD., Croston Street, Bolton, Lancs.	"Standard Super"	Round	28 × 17½ diameter	10 gal	No	No	3 kW	Foot-press switches
	No. 7	Round	24 × 16 diameter	7½ gal	No	No	2 kW	Foot-press switches
	"Dinky"	Round	20 × 17½ diameter	5½ gal	No	No	2 kW	3-heat rotary switch
HERMAN SMITH SMITHLITE, LTD., Empire Works, Dudley, Worcs.	G.1953	Round	26 × 17½ diameter	10 gal	No	No	3 kW	3-heat rotary switch
	G.1953S.C	Round	26 × 17½ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out
	E.1953	Round	26 × 17½ diameter	10 gal	No	No	3 kW	3-heat rotary switch
	E.1953S.C	Round	26 × 17½ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out
TAYLOR & WILSON, LTD., Taywil Works, Accrington, Lancashire.	"Marvel"	Round	19½ × 15½ diameter	5 gal	No	No	2 kW	3-heat rotary switch
	"Marvel"	Round	21½ × 17½ diameter	7½ gal	No	No	2½ kW	3-heat rotary switch
F. J. TOMLINSON, LTD., Albion Mill, Rawtenstall, Lancs.	"Handy"	Round	12 × 15½ diameter	4½ gal	No	No	1½ or 2 kW	Ejector safety device
TREFOREST ELECTRICAL SERVICES, LTD., Pengham Road, Aberbargoed, Bargoed, Glam.	350	Round	28½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	351	Round	28½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	352	Round	28½ × 19 diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	353	Cabinet	28½ × 18½ × 18½	10 gal	No	Optional extra	3 kW	Press-button 3-heat switch
	354	Cabinet	28½ × 18½ × 18½	10 gal	Yes	Optional extra	3 kW	Press-button 3-heat switch

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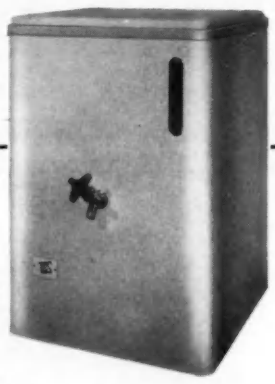

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Exterior Finish	Tub Finish	Price
Enamelled all-white or all-cream or with turquoise blue or eau-de-nil table top	Tinned copper	£12 12 0
Enamelled all-white or all-cream or with turquoise blue or eau-de-nil table top	Tinned copper	£13 17 0
Galvanised	Tinned copper	£9 7 6
Galvanised	Tinned copper	£7 17 6
Stoved enamel	Tinned copper	£7 5 0
Galvanised	Tinned	£9 14 6
Galvanised	Tinned	£10 19 6
Galvanised	Tinned	£11 10 0
Stove enamelled	Tinned	£12 15 0
Cream and maroon stoved enamel	Anodised aluminium	£7 7 0
Cream and maroon stoved enamel	Anodised aluminium	£8 19 6
Galvanised	—	£3 11 9
Galvanised	Tinned	£10 0 0 (s.p. switches) £10 6 0 (d.p. switches) £11 5 0 (a.c. cut-out)
Cream, white, blue or red stoved enamel	Tinned	£11 10 6 (s.p. switches) £11 16 6 (d.p. switches) £12 15 6 (a.c. cut-out)
Cream, white, blue or red stoved enamel	Tinned	£12 13 6 (s.p. switches) £12 19 6 (d.p. switches) £13 18 6 (a.c. cut-out)
Cream or white stoved enamel	Tinned	£15 12 6 £16 17 6 (a.c. cut-out)
Cream or white stoved enamel	Tinned	£24 9 6 (incl. p.t. on wringer

18

19

15. *Tomlinson "Handy" 4½ gal boiler*
16. *Treforest model 353 10 gal cabinet wash boiler*
17. *Taylor & Wilson "Marvel" 5 gal boiler*
18. *Herman Smith "Smithlite" galvanised 10 gal boiler*
19. *"Jackson 908/9" cabinet wash boiler (Electrical Division of Radiation, Ltd.)*

American Measurement Research

THE latest annual report of the National Bureau of Standards (U.S.A.) describes a wide range of scientific studies, laboratory experiments, instrument developments, and technical publications. The Bureau's basic role is in the science of measurement which includes developing and improving physical standards and standard materials; developing, refining, and fostering the use of measuring techniques and instruments; and determining precisely properties of materials not known with sufficient precision elsewhere.

Industry needs gauge blocks calibrated to an accuracy of one part in ten million, missile and aircraft development requires new and improved heat resistant coatings, metals and alloys, telemetering equipment and, above all, new and improved measuring methods and equipment. Progress in the continuing effort to increase the range and precision of physical measurements is detailed in the report. Constructing an improved standard of capacitance, developing piston gauges for use at pressures up to 200,000 p.s.i., increasing the accuracy of pyrometer calibrations at temperatures between 2,000 and 4,000 deg C, and an atomic beam wavelength source to act as a standard of length are a few such projects completed or advanced during the year.

Asbestos Insulating Paper

UNTREATED asbestos paper for use as electrical insulation, with specified nominal thicknesses ranging from 0·13 to 0·25 mm, is covered in B.S. 3057 : 1958. Two types of paper are classified, depending upon the amount of organic binder used. The second type, with the greater quantity of binder, has an increased mechanical strength and a minimum number of conducting paths. Among the tests specified are those for electrical, tensile and bursting strength, substance, moisture content, freedom from conducting paths and loss of weight on ignition after drying. A recommended form of pneumatic tester for the bursting strength test is described, and it is hoped that this will eventually be adopted as standard throughout the industry. The 21-page specification is issued under the authority of the Electrical Industry Standards Committee and is based on a report prepared by the Electrical Research Association. The methods of test in the standard are based—where applicable—on those of the British Paper and Board Makers' Association.

Copies of this Standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 6s.

PARLIAMENTARY REPORT

Diesels Defended

In the House of Lords last week Lord Monkswell contended that instead of building a large number of diesel-electric engines to cover the period before complete electrification was possible, the British Transport Commission should have reverted to the steam locomotive, using coal, now plentiful, instead of imported oil.

Lord Gosford, replying, said that one main-line diesel-electric engine could do the work of at least two steam locomotives. The "Deltics," which were the most powerful of this type, would be introduced in 1960 and 1961 between King's Cross and Edinburgh. Twenty-two of these locomotives would replace 55 steam locomotives. For main-line working to and from the West of England 129 diesel hydraulic engines would replace a total of over 200 steam locomotives. The substitution of diesel for steam in the Bristol area would require 157 diesels to replace 300 steam locomotives. In East Anglia and the North of Scotland 820 steam locomotives would be replaced by 325 diesels. This reduction in traction units not only gave the Commission substantial savings in running and maintenance costs; it also helped to offset the high first cost of the diesel as compared with its steam counterpart. He also listed the great operating advantages that electric and diesel trains had over steam trains.

In answer to Lord Ferrier, who asked whether engine designers had been able to develop a diesel-electric engine which could switch to an overhead electric supply, Lord Gosford said it was technically possible for them to be devised so that when they arrived at an electrified section they could put up the pantograph and carry on using electric current direct, but there were in fact no such locomotives either in service or under manufacture. At present the Commission's resources were at full stretch in implementing the electrification schemes.

Lord Hurcomb, former chairman of the Commission, said they had a very good case for using the diesel locomotive as an interim or stop-gap locomotive until they could get full electrification. "But I hope that policy will not delay the full completion of the electric transport system which I believe to be the best adapted to the circumstances of this country and best suited to the national economy," he declared.

Electricity and Rates

In the debate on the Rating and Valuation Bill (which postpones the use of the next revaluation lists until 1963) Mr. Arthur Skeffington told a remarkable story about 1,200 council houses at Hayes which had to be revalued "because the fact that the houses had electricity was unnoticed by those carrying out the valuation." When this omission came to the notice of the local valuation office the assessments were increased by £2.

Television Systems

The prospects of a change in the line definition of British television were explored by Mr. Charles Hobson in an adjournment debate. He said that if there was to be a change it should at least coincide with the advent of colour television.

Mr. Kenneth Thompson, Assistant Postmaster-General, said that although he was advised that the 625 line system would give a better picture than the present one (405 lines) no Government would ever render obsolete by the stroke of a pen or by an Order-in-Council eight or nine million television sets. If it became technically and overwhelmingly advisable to make the change then clearly it would be made over a prolonged period in a way which would enable people, as their sets became obsolete, to accommodate themselves to the change. The decision, since colour would be best broadcast on 625 lines, might hinge on what was decided about the introduction of colour, which, in all probability, was some years away.

Tube Railway Construction

In reply to Sir Wavell Wakefield, the Minister of Transport (Mr. Harold Watkinson) said that London Transport's broad estimate of the measure of the labour element involved in a six-year programme to build the Victoria Line tube and its rolling stock was not less than 50,000 man-years. It was more difficult to estimate the total labour involved in the same expenditure on road schemes, but it would probably be of the order of one-tenth of the tube figures.

Purchase Tax Questions

The spring-time flush of questions on the subject of purchase tax finds Mr. Amory, the Chancellor of the Exchequer, as unruffled as ever. His words are always a variation of the time-honoured phrase "My honourable friends will not expect me to anticipate my Budget decisions." Members have pointed out the bad effect on trade of the present system of charging purchase tax, and Mr. Nabarro has again produced many anomalies which are ridiculous. Mr. Amory, when confronted by such cases, has indicated that he is, "in the interests of justice, having regard to all appropriate considerations."

Electronic Control in Industry

Mr. Mikardo raised with the Chancellor of the Exchequer the question of public support for research on automation and electronic control. He said that Britain was falling behind her competitors. Almost all the transfer machines at present being installed in British factories were being imported and our biggest transfer machine manufacturer had just laid off half his staff, he said. Would the Chancellor consult with other Ministers to see what can be done to remedy this grave situation?

Mr. Amory said he would consider this. He agreed that this had great importance in industrial development and was of the utmost importance to the country as a whole.

U.K. and Common Market Tariffs

External tariffs are one of the biggest stumbling blocks in the way of co-operation between the United Kingdom and the Common Market countries in a Free Trade Area. The British idea of differing external tariffs linked with certificates of origin to prevent abuse has been rejected; the British reply to the demand for harmonisation of external tariffs is that we cannot abandon our freedom to alter our tariff nor modify its structure because of the Imperial Preference system. A better understanding of what is involved is now made possible by a report, "A Comparison of the United Kingdom Tariff and the Proposed Tariff of the European Economic Community" (price 10s), which has been prepared for the Federal Trust for Education and Research by the Economist Intelligence Unit. Indicating the large amount of identity and similarity between the two tariffs, the report points out that by agreeing to harmonise tariffs the U.K. could secure a voice in the negotiation of tariffs on the 18 per cent of total imports and 14 per cent of Commonwealth imports of goods for which the E.E.C. tariff has still to be settled. Over the greater part of the trade in manufactures the U.K. general tariff and the proposed E.E.C. tariff are within a few per cent of each other. Tariffs on foodstuffs (35 per cent of total U.K. imports) are the real obstacle, the E.E.C. duties being 15 to 20 per cent higher than the U.K. general tariff.

Electrical Housecraft Conference

A one-day conference on the teaching of electrical housecraft, organised by the Electrical Association for Women, will be held on 18th April at St. Wulfram's Secondary Modern School, Grantham. The conference fee is 5s and particulars can be obtained from the E.A.W., 25, Foubert's Place, London, W.1.

NEW ELECTRICAL EQUIPMENT

Three Digit Voltmeter

The three digit voltmeter model D101 introduced by FERRANTI, LTD., Hollinwood, Manchester, Lancs., measures d.c. voltages with an accuracy of 0·1 per cent on any of three ranges, 0·01 to 9·99 V, 10 to 99·9 V and 100 to 999 V. The average reading time is 0·7 second and automatic ranging, polarity and decimal placing are incorporated.

The input voltage to be measured is compared with the output from a

Ferranti digital voltmeter

Kelvin-Varley potentiometer and any difference actuates stepping switches until a balance is achieved, enabling the measured voltage to be presented digitally in the form of ¾in high illuminated numerals in a 1¼in by 5¼in display area. The reference voltage is obtained from a bank of mercury cells. Stability is achieved by using a transistorised amplifier and high grade choppers, the accuracy of the instrument being unaffected by mains variation.

The indicator unit can if necessary be remote from the voltmeter or other digital instrument. An a.c. to d.c. convertor is at present under development for use in conjunction with this voltmeter. The instrument is contained in a bench style cabinet measuring 17in by 13in by 10½in high, and the weight is approximately 50 lb.

Interlocking Relay

The Series 593 relay is an interlocking unit, manufactured by MAGNETIC DEVICES, LTD., Exning Road, Newmarket, Suffolk, designed for alternate switching between circuits, suitable for such applications as flow control motors, positioning devices and sorting mechanisms. The unit comprises a pair of mutually interlocking relays available as an open relay on a two-position mounting bracket, or, alternatively, enclosed or hermetically sealed.

Magnetic Devices interlocking relay

Either or both coils can be supplied for a.c. or d.c. operation and multiple contact assemblies may be fitted to either or both relays. The contacts are rated for 5 A at 30 V d.c. or 250 V a.c. with a resistive load, and the maximum nominal coil voltage is 140 V d.c. or 250 V a.c.

Dual Temperature Alarm

A self-contained unit giving audible alarm in the event of excessive temperature rise or fall beyond a preset value, comprising two capillary type thermostatic switches, magnetic relay, buzzer and dry battery enclosed in an enamelled pressed steel case, is being produced by TEDDINGTON INDUSTRIAL EQUIPMENT, LTD., Windmill Road, Sunbury-on-Thames, Middlesex. Non-corrodible contacts are fitted to both switches, and an alarm test position is provided enabling a functioning check to be made.

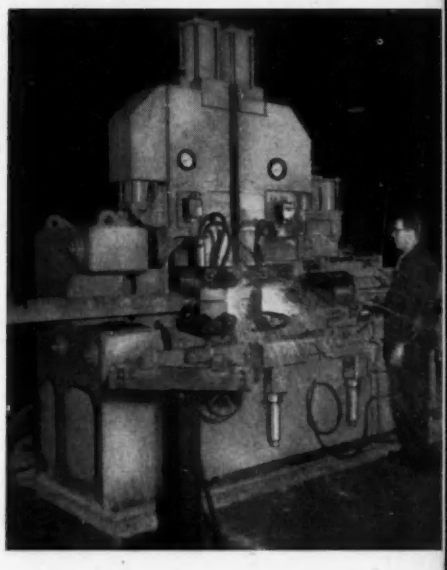
Motorised Grinding Head

The model 58/V6 column mounted surface grinder, introduced by WRIGHT ELECTRIC MOTORS (HX), LTD., Century Works, Pellon Lane, Halifax, incorporates a grinding head in which fine adjustment is obtained by lateral movement of the motor rotor. A push-button direct-on-line starter controls the totally enclosed dust-proof squirrel cage motor which develops 1·5 h.p. at 2,900 r.p.m. when operating from a 50 c/s supply, or 1·75 h.p. at 3,500 r.p.m. if wound for a 60 c/s supply. A 6in diameter grinding wheel is fitted, and the maximum distance between the table and the wheel is 10in.

Wright surface grinder

Butt Welding Machine

The type APFH/18T heavy duty flash butt welding machine introduced by A.I. ELECTRIC WELDING MACHINES, LTD., 68, Victoria Street, London, S.W.1, has a maximum mild steel welding capacity of 12 sq in cross-sectional area. In addition the machine incorporates provision for welding tubes up to 6½in diameter. A fettling unit can be fitted to remove internal weld upset which occurs when welding short tubes to longer lengths, for example, the re-ending of boiler tubes. One fixed and one sliding clamping unit are employed, operated from a two-stage air/oil intensifier system, applying a load of 27 tons for final clamping. The 6in vertical clamping stroke permits a wide variation in workpiece size and shape. Vertical and horizontal adjustment under full clamping pressure is available for accurate alignment. The forging unit, using the same air/oil intensification principle, applies an 18 ton pressure, and pre-heating is accomplished by reciprocating the sliding clamp unit to make and break the contact between the mating surfaces. A 350 kVA water-cooled single-phase transformer is mounted as a separate unit at the rear of the machine, giving easy access to adjust the range of secondary voltage tappings. Air and water demands are 20 cu ft of air at 80/100 p.s.i. per weld, and 240 gallons of water per hour.



A.I. Electric Welding Machines butt welder

Financial Section

STOCKS and SHARES

THE annual reports and dividend declarations in respect of 1958, now appearing in increasing numbers, are tending to confirm investors in their marked preference these days for the manufacturers and retailers of household goods, especially of refrigerators, washing machines, electrical and other domestic equipment of the kind most affected by the relaxation of the hire-purchase restrictions last October. The extent of the improvement in the Hoover company's preliminary statement gave a particularly striking example of the expansion which is occurring in these fields, and it has been supported by other companies engaged in similar spheres of activity. In general, the industrial markets of the Stock Exchange have again been showing no particular sense of direction, with the tendency if anything towards the dull side. Shares of the leading electrical engineering groups have, however, continued to be reasonably well upheld.

Hoover Results

Last year's reductions in purchase tax, and the subsequent removal of hire-purchase restrictions, had encouraged high hopes of the Hoover company's figures for 1958, and these were proved fully justified by the report of increases of some 28 per cent in turnover, of more than 50 per cent in the gross trading profit, and of 10 per cent in the ordinary dividend, which is being brought up to a total of 60 per cent. Already at a high level in advance of the announcement, the price of the 5s shares was subsequently a little reactionary at 63s 6d. At this level they offer a yield of approximately 4¾ per cent. The tax charged on the 1958 profits is almost doubled at £3·1 million, leaving the net group profit some £470,000 to the good at £2·4 million, so that the company is able to make the dividend increase while retaining a considerably larger proportion of the surplus for employment in financing projects still in the course of development.

Domestic Equipment

Morphy-Richards 4s shares came in for good support, rising to 22s 6d, after the announcement of an increase from 8 to 10 per cent in the interim dividend on account of the year ending next June. Other recent news from the field of domestic equipment has included a preliminary statement from Bylock Electric on the results for the year ended last July. That period covered the worst of the credit squeeze, and ended before any benefit could have been derived from the removal of hire-purchase controls, but the group profit of £128,000 is only moderately below the record figures of the previous year and provides ample cover for the maintenance of the dividend at 33⅓ per cent, as before. The price of the 1s shares improved subsequently to 4s 6d, at which level the yield is nearly 7½ per cent. Ada Halifax 1s shares were marked up to 3s 3d after the announcement of a coming rights issue of new shares in the proportion of three for every eight held, at a price of 1s 9d,

Price Changes in

Company or Board	Nom. Value	Middle price 2nd March	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1958 Highest	1958 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78¼x.d.		3	3	3 16 6	77	72
Brit. Elec. 1974/77	100	75½	−½	3	3	3 19 6	73½	68½
Brit. Elec. 1976/79	100	80½		3½	3½	4 7 0	78½	72
Brit. Elec. 1974/79	100	88½		4½	4½	4 16 0	87½	82½
Overseas Electric Supply								
Calcutta Elec.	£1	17/-		6·8†	7†	14 5 0	17/6	15/-
East African Power	£1	20/6	−1/6	7½	8	7 16 0	23/-	17/6
Nigerian Elec.	£1	15/-		10	10	13 6 9	17/-	12/6
Perak Hydro-Elec.	£1	14/-		12½	10	14 5 6	15/6	13/6
Electrical Shares								
Aberdare Holdings	5/-	16/-		17½	17½	5 9 6	15/9	9/9
Aerialite	1/-	8/6		51½	54	6 7 0	8/6	5/1
Allen, W. H.	£1	43/9		10	11	5 0 6	43/9	32/9
Anglo-Portuguese Tel.	£1	28/3		8	9	6 7 6	29/3	19/9
Aron Elec. Ord.	£1	60/-		15	15	5 0 0	61/3	53/-
Assoc. Elec. Ord.	£1	55/-		15	15	5 9 0	58/9	46/6
Automatic Tel. & El.	£1	80/-		17	17	4 5 0	75/-	57/-
Babcock & Wilcox	£1	51/3		15	13‡	5 1 6	54/6	41/9
Bakelite	10/-	24/3	+1/6	15	15	6 3 9	23/-	17/6
Baldwin, H. J.	2/-	2/6		20	20	—	3/9	2/6
Berry's Electric	5/-	11/9	+3d	10	10	4 5 0	11/3	5/9
Bowthorpe Holdings	2/-	12/3		37½	25*	4 1 9	11/9	6/6
British Elec. Traction: Def. Ord. "A"	5/-	36/3	−1/3	25	25	3 9 0	40/-	19/6
B.I. Callender's	£1	48/-		12½	12½	5 4 3	52/-	38/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/3	19/-
British Thermostat	5/-	38/9	+9d	25	30	3 17 6	36/3	19/9
British Vac. Cleaner	5/-	7/6	+6d	10	7½*	5 0 0	4/6	2/3
Brook Motors	10/-	51/3		25	24½*	4 14 0	45/-	27/9
Bulgin, A. F.	1/-	7/9	+3d	40	45	5 16 3	7/-	4/7
Bulpitts	5/-	12/-	+1/-	—	12½‡	5 4 3	11/-	7/3
Burco Dean	5/-	12/6	−3d	22½	16*	6 8 0	12/6	7/9
Cable & Wireless: Ord.	5/-	12/9	−6d	10	10*	3 18 6	13/-	8/-
4% Loan	100	94½		4	4	4 4 9	94½	89
Chloride El. Storage "A"	£1	70/-		17½	17½	5 0 0	68/9	55/6
Clarke Chapman	£1	61/3	+3d	27½	13¾*	4 9 9	72/6	55/-
Cole, E. K.	5/-	19/3		17½	17½	4 11 0	18/-	15/3
Contactor Switchgear	5/-	12/6		20	14*	5 12 0	13/-	9/-
Cossor, A. C.	5/-	7/3	−3d	2½	Nil	Nil	7/9	4/4
Crabtree	10/-	29/-x.d.		20	20	6 18 0	32/-	24/4
Crompton Parkinson	5/-	12/9		16	12*	4 14 0	13/9	8/3
Davis & Timmins	5/-	15/-		22½	18	6 0 0	16/3	10/3
De La Rue	10/-	31/3	−9d	35	17½*	5 12 0	34/-	20/9
Decca "A"	4/-	36/3	−9d	43¾	50	5 10 3	37/6	21/3
Desoutter	5/-	19/9		32½	18¾*	4 15 0	19/3	13/6
Dewhurst	2/-	7/6		20	20	5 6 9	9/3	6/9
Dictograph Tel.	2/-	7/6		20	20	5 6 9	7/3	4/7
Dubilier Condenser	1/-	3/6		30	20*	5 14 3	4/3	3/1
Duport	5/-	10/6		25	12½*	5 19 0	10/9	7/9
E.M.I.	10/-	53/-	−3/9	15	20*‡	3 15 6	52/6	20/9
Electrical Components	5/-	11/6		12½	12½	5 8 9	10/9	7/-
Elec. Construction	£1	30/-	+1/3	8½	8½	5 13 3	28/9	21/-
Elliott-Automation	5/-	17/6		—	10‡	2 17 3	19/9	11/6
Enfield Cable Ord.	£1	20/-	+6d	Nil	2½	2 10 0	18/9	10/9
English Electric	£1	63/9x.d.	+1/-	14	14	4 7 9	60/-	44/-
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/6	11/9
Ericsson Tel.	5/-	26/9		22†	12*‡	3 17 3	26/3	17/6
Ever Ready	5/-	26/3		37½	20*	3 16 3	22/3	13/9
Falk Stadelmann	£1	48/-		17½	15	6 5 0	46/3	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

and the forecast of a 15 per cent final dividend on capital so increased.

Mixed Changes

The spectacular rise in Vactric 5s shares continued from 37s 6d to 42s 6d before there was a partial reaction to 40s. Thorn Electrical, at 34s 6d, also lost a part of the very substantial advances of previous weeks. E.M.I. came back 3s 9d to 53s, and International Computers 1s 3d to 68s. Lancashire Dynamo, however, added a further 1s 3d to earlier gains, reaching 47s 6d, while Electric Construction improved to 30s, and there were noteworthy gains elsewhere in Bulpitts, Walsall Conduits, A. F. Bulgin, Strand Electric and a few others. Metal Industries moved up 4s 6d, with Avo sympathetically higher at 10s 9d. Mather & Platt eased further to 42s 6d ex-dividend, still under the influence of the previously reported contraction of profits in 1958. Dividends for this period are equivalent to a total of 10⅝ per cent on the present capital, as increased by a 50 per cent scrip issue, and represent a fractional increase on the previous year's distribution.

Electrical Investments

Company or Board	Nom. Value	Middle price 2nd March	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1958 Highest	1958 Lowest
Electrical Shares—continued						£ s d		
G.E.C.	£1	32/6x.d.	+3d	12½	10	6 3 0	40/-	29/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9		24	15	8 11 6	11/9	8/3
Greenwood & Batley	£1	79/6		17½	20	5 0 9	57/6	45/-
Hackbridge Holdings	5/-	15/3		20	20	6 11 3	15/3	7/6
Hackbridge & Hewittic	5/-	15/-		20	20	6 13 3	14/6	9/7
Head Wrightson	5/-	25/9	−3d	22½	17½*	3 8 0	26/-	16/9
Heatrae	2/-	9/-		15	20	4 9 0	7/9	4/-
Holophane	5/	15/9		37½	22½r	7 2 9	15/6	12/6
Hoover	5/-	63/6	−6d	50	60	4 14 6	58/6	31/-
I.C.I.	£1	35/6		10	12	4 10 3*	37/6	23/9
Intl. Combustion	5/-	33/9x.d.	+9d	25	30‡	4 9 0	28/3	19/3
Intl. Computers & T.	£1	68/-	−1/3	—	8‡	2 7 3	—	—
Johnson & Phillips	£1	24/6		10	5	4 1 9	25/-	15/-
Lancashire Dynamo	£1	47/6	+1/3	11	11	4 12 6	45/-	28/6
Laurence Scott	5/-	17/3		15	15	4 7 0	16/9	12/6
Lister, R. A.	£1	40/-	+1/-	10	12½	6 5 0	34/6	23/-
London Elec. Wire	£1	70/-		12½	12½	—	72/-	39/6
Lucas, J.	£1	45/-	−3d	7½	10‡	4 8 6	45/-	27/9
Marconi Marine	£1	41/3x.d.		10	10	4 17 0	40/-	29/-
Marryat & Scott	2/-	9/-		35	37½	4 3 3*	8/9	5/3
Mather & Platt	£1	42/6x.d.	−1/-	15	10§*	5 0 6	50/6	29/6
Metal Industries	£1	45/6	+2/-	9	14	6 3 0	44/-	22/9
Midland Elec. Mfg.	£1	42/6		12½	10*	4 14 3	41/3	26/6
Morphy-Richards	4/-	22/6	+2/6	20	20	3 11 0	20/-	14/6
Murex	£1	45/-		20	17½	7 15 6	59/3	46/9
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	2/6		17½	17½	7 0 0	3/-	2/3
Parsons, C. A.	£1	51/3	−6d	8½	7½*	2 18 6	55/-	43/-
Plessey	10/-	72/6		30	30	4 2 9	72/6	55/-
Pye	5/-	15/3	−1/3	12½	12½	4 2 0	17/-	10/-
Pyrotenax	5/-	35/-	−6d	—	27½‡	3 17 6	37/-	27/6
Reliance Clifton	5/-	18/6		13½	15	4 1 0	19/9	9/-
Reyrolle	£1	94/6	+9d	17½	17½	3 14 0	93/9	73/6
Rheostatic	4/-	8/9		12½	12½	5 14 3	8/6	6/-
Richardsons Westgarth	10/-	14/9		16§	8½*	5 13 0	15/9	13/-
Scottish Cables	4/-	15/3		27½	27½	4 4 0*	12/3	7/-
Simon-Carves	5/-	30/9	−6d	20	25	4 1 3	31/3	22/6
Smith (England), S.	4/-	12/3		20	12½*‡	4 1 9	12/3	7/-
Southern Areas	£1	12/-	−9d	7½	Nil	Nil	13/9	9/3
Strand Elec.	5/-	9/3	+6d	15	15	8 2 3	9/3	4/9
Sturtevant	5/-	18/6	+6d	15†	15†	7 1 0	19/6	14/9
Sun Elec.	£1	70/6		25	25	7 1 9	60/6	47/3
Switchgear & Cowans	5/-	11/9		25	22½	4 15 9*	9/9	4/6
Taylor Tunnicliff	5/-	18/9	+6d	15	17½	4 13 3	18/3	11/9
T.C.C.	10/-	39/-		25	25	6 8 3	38/6	32/6
Telephone Mfg.	5/-	5/3		10	10	9 10 6	5/9	4/3
Telephone Rentals	5/-	13/-		12½	12½‡*	4 16 3	14/6	9/9
Thompson (John)	5/-	23/9		25	25	5 5 3	27/-	23/-
Thorn Elec.	5/-	34/6	−1/9	17½	17½	2 10 9	25/-	17/-
Thornaycroft	£1	21/3		12½	7½	7 1 3	30/9	21/-
Tube Investments	£1	83/-	+1/3	15	17½	4 4 3	81/3	48/3
Vactric	5/-	40/-	+2/6	25	25	3 2 6	—	—
Veritys	5/-	2/6		12½	2½	—	6/9	5/3
Walsall Conduits	4/-	18/3	+6d	20	22½	4 18 9	18/3	11/-
Ward & Goldstone	5/-	37/6		40	25*	3 6 9	37/-	23/6
Watford	2/-	8/-		25	25	5 0 0*	8/-	4/-
Westinghouse	£1	43/9		10	10	4 11 6	45/-	32/3
West, Allen	5/-	12/9	+3d	15	12½*	4 11 6½	13/3	7/9
Wolf Electric	5/-	8/3		20	10*	6 1 3	9/-	6/9

Electrical Equipment

English Electric shares, at 63s 9d ex-dividend, more than maintained the recent rise in price after the appearance of the full report. Comment on this was favourably impressed by the fact that the value of the group's order book at £238 million was very little smaller than it had been a year earlier, despite the record turnover intervening. Profit margins, however, have evidently remained narrow. From the point of view of orders on hand, the International Combustion company's full report also disclosed a satisfactory position. After a year in which output was considerably increased, the order book was nevertheless much larger at the end of it than at the start. Crompton Parkinson shares have been in demand since the announcement of the British Transport Commission's orders for diesel locomotives; they have been changing hands in the market up to 13s 6d.

Electronic Trust

Dealings began last week in the £1 shares of the Electronic Trust at a price of about 23s 6d. According to the particulars published in connection with the marketing of these shares, the policy of the company, which was formed in 1955, is to invest principally in the securities of firms engaged in the fields of electronics, automation and nuclear power. On the basis of a market valuation taken last January, the company holds investments worth rather more than £2 million, of which some 46 per cent is represented by the stocks of companies registered here or in Europe and the remainder in North America. Profits for the year ending next May are estimated at £70,400, out of which it is intended to pay a dividend of 3½ per cent.

Electron Microscope Chart

A sectional view of the Metropolitan-Vickers type EM6 electron microscope is shown on a wall chart which has recently been produced primarily for use in technical colleges and institutions. Official requests for copies from lecturers and science teachers should be addressed to the Publicity Department, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, 17.

REPORTS and DIVIDENDS

English Electric Group. — The preliminary figures in the accounts for 1958 of the companies in this group were given in our issue of 20th February. In the full accounts now issued, the directors of the English Electric Co., Ltd., refer to the continued expansion of the group's manufacturing and sales activities overseas. In this country the English Electric, Babcock & Wilcox and Taylor Woodrow Atomic Power Construction Co., Ltd., has been formed to handle the contract for Hinkley Point atomic power station, and Associated Transistors, Ltd., has been formed by Automatic Telephone & Electric Co., Ericsson Telephones, Ltd., and the English Electric Co., to manufacture semiconductor devices at Ruislip. In January English Electric Aviation, Ltd., was incorporated to take over the research, design and development activities of the company's aircraft and guided weapons divisions. The company's manufacturing capacity in this country has been further expanded during the year, and a new factory is under construction at Stafford for the manufacture of the larger transformers. The annual meetings of the group will be held on 19th March.

International Combustion (Holdings), Ltd.—The report and accounts for the year ended 30th September last, now issued, confirm the figures given in our issue of 20th February.

In his statement, which has been circulated with the accounts, Sir James Reid Young (chairman) says that the value of orders on hand at the end of the year showed a substantial increase over the figure at the close of the previous year. Their principal home purchaser, the C.E.G.B., from whom they received the order for the large unit for Thorpe Marsh in February, 1958, did not issue any major inquiries until late 1958. The amount of business to be placed by the C.E.G.B. in 1959 is, as at present advised, somewhat less than that available in earlier years and the total amount of business from this source is likely to be less than that of the previous year. Construction of the new heavy engineering shop is progressing satisfactorily and manufacturing operations commenced in December last, although all the machinery will not be finally installed until the end of the present month. The output from all the works in the group showed a reasonable increase over the previous year, and the total value of the group's turnover for the year showed a substantial increase and established an all time record. An appreciable portion of this increase resulted from deliveries to the home boiler plant market and in particular the increase in general industrial plant specialities was again gratifying.

Turning to the subsidiary and associated companies, the chairman says that International Combustion, Ltd., established a further record in the home boiler business and among a number of large units commissioned for the electricity supply industry was the first 120 MW reheat boiler unit put into service for the South of Scotland Electricity Board. Development work in respect of even more advanced coal-fired steam plant boiler units has proceeded actively through the year in consultation with the C.E.G.B. The manufacturing side of the Buenos Aires power station contract by International Combustion (Export), Ltd., comprising five 120 MW reheat boilers, has proceeded and shipments of materials are already in progress. Of new plant commissioned in the year, important installations were completed in India, Hong Kong and the Lebanon. It would appear generally that prospects in the export market are not as encouraging as was the case a year ago, due to a combination of over-expansion of manufacturing facilities and a present reduction in demand.

Since the close of the year a further small number of additional shares in Atomic Power Constructions, Ltd., have been taken up and International Combustion (Holdings) is now the major shareholder. Satisfactory progress was made during the year by International Combustion (Nuclear Applications), Ltd., with design and contract work principally for the Atomic Energy Authority, while shortly before the close of the financial year a tender was lodged for heat exchangers and ancillary apparatus for the Authority's Industrial Group's advanced experimental reactor at Windscale; this tender has been accepted. After briefly reviewing the activities of the other companies in the group, the chairman says that they are now almost halfway through the current year and their output is being maintained at a satisfactory rate, so that at present there is no reason to suppose that the results of the year's working will differ materially from those of 1957-58.

The British Vacuum Cleaner & Engineering Co., Ltd., held its annual meeting on 27th February, Mr. O. D. Angell (chairman) presiding.

In the course of his speech, the chairman said that the balance sheet position was strong and given the anticipated further improvement in their earning ability, the board would seek to place the finances of the company on a more permanent basis. In the domestic section of their activities they had had some assistance from a reduction in purchase tax and the decontrol of hire-purchase. The new lower priced range of cleaners found an immediate response from the trade and the company created a record both in the manufacture and the sales of domestic cleaners. "Teasmades" continued to sell at a reasonably high rate, and again they had a record year in sales of this device. New products were in the offing.

In the export division they had not accomplished all that was possible and a new approach to this potential was under way. In the industrial vacuum cleaner division they were maintaining their position and particularly in the export field there was a healthy outlook. With regard to pneumatic conveying, the development section was employing new techniques, and new models to meet changing conditions were under way, particularly relating to the United Kingdom Atomic Energy Authority. They had added to their industrial vacuum cleaner section a new range of floor maintenance equipment which gave promise of a reasonably wide acceptance, both at home and overseas. The Magneta Time Co. division continued to expand its operations in the sale of time recorders, clock systems and public address equipment. They were maintaining their exports in this field, but licensing arrangements in Australia and New Zealand restricted, in some measure, the sale of these products. In the electronics division they had increased their range of small special motors. Certain changes in manufacture and sales policy had been put into operation and they were committed to further mechanisation in the works and additional plant. The sales organisation had been overhauled and strengthened and the fusion of interests in sales and production was having the desired effect.

The Midland Electric Manufacturing Co., Ltd., reports group trading profits for 1958 of £487,152, as compared with £504,817 for 1957, to which is added investment income of £26,688. Taxation absorbs £267,040, and the net profit is £246,800 (against £241,843). It is proposed to pay a dividend for the year of 10 per cent on capital increased by a two-for-three scrip issue (against 15 per cent, including a jubilee bonus of 2½ per cent, on the smaller capital).

Lindley Thompson Transformer & Service Co., Ltd.—An unconditional offer is to be made by Guinness Mahon & Co. on behalf of Pye, Ltd., to acquire all or any of the ordinary 1s shares of Lindley Thompson Transformer & Service Co. at 2s 6d a share and all or any of the £1 redeemable preference shares at 16s a share. The directors of Lindley Thompson and trustees of certain family trusts set up by Mr. J. Lindley Thompson will accept the offer in respect of their holdings, totalling about 33⅓ per cent of ordinary shares and 76 per cent of the redeemable preference shares.

Relay Exchanges, Ltd.—The group trading profits, including those of Goodman Industries, for 1958 were £2,304,637, as compared with £1,503,670 for 1957, subject to audit. Depreciation and reserve for renewals requires £1,453,470 and taxation absorbs £469,273, leaving a net profit

of £381,894 (against £236,288). It is proposed to pay a final dividend of 12½ per cent, making 20 per cent for the year, and in addition to pay a special non-recurring dividend of 2½ per cent (to be charged against the 1959 accounts) on capital increased by a one-for-five rights issue and a one-for-one scrip issue and issues against acquisitions. The total payment for 1957 on the smaller capital was 40 per cent.

Hoover, Ltd., in a preliminary statement, report a group profit for 1958 of £5,847,490, as compared with £3,757,312 for 1957, and after deducting United Kingdom taxation of £3,162,635, the net balance is £2,409,283 (against £1,939,310), of which £2,339,980 is attributable to the parent company. It is proposed to pay a final dividend on the ordinary and "A" ordinary capital of 50 per cent (against 40 per cent), making 60 per cent (50 per cent) for the year.

Ada (Halifax), Ltd., proposes to make a three-for-eight rights issue at 1s 9d per 1s share. The net proceeds are estimated at £250,000, which is to be used for factory extensions and new plant and machinery.

Bylock Electric, Ltd., reports a group profit for the year ended 31st July last of £127,775, as compared with £132,051 for the preceding year. Taxation absorbs £71,462 and it is proposed to pay a dividend for the year of 33⅓ per cent (unchanged).

Falk, Stadelmann & Co., Ltd., announce that the extraordinary meeting convened for 13th March to consider the proposed scrip and "rights" issues, reported in our last issue, will now be held on 20th March.

Taylor, Tunnicliff (Electrical Industries), Ltd., reports group profits for the year ended 31st December last, after providing £241,880 for taxation, of £216,245, as compared with £191,147 for the preceding year. The dividend for the year is unchanged at 17½ per cent.

Morphy-Richards, Ltd., have announced an interim dividend of 10 per cent (against 8 per cent).

Parmiter, Hope & Sugden, Ltd., have declared an interim dividend of 7½ per cent (unchanged).

New Companies

Hamilton House Electrics, Ltd.—Registered 18th February. Capital £100. Importers, exporters and manufacturers of and dealers in household appliances and fittings, electrical goods, radio and television receivers, components and accessories, etc. Directors: D. Goldring, S. Goldring and Eileen R. Pinnell. Regd. office: 11, Stanhope Gate, Park Lane, W.1.

Vikglas, Ltd.—Registered 13th February. Capital £1,000. Manufacturers of and dealers in electrical incandescent bulbs, lamps, radio valves, neon lights, etc. Directors: E. H. Moore and Mrs. Victoria Moore. Regd. office: 468, Walton Road, West Molesey, Surrey.

Revco Radio Services, Ltd.—Registered 16th February. Capital £100. Retailers of, agents for and manufacturers of and dealers in electrical goods, equipment and apparatus of all kinds, etc. Regd. office: 77, Portland Place, W.1.

Meeting of Creditors

Veritys, Ltd.—A meeting of creditors will be held on 9th March at the office of the company, Hazelwell Works, Fordhouse Lane, Stirchley, Birmingham, 30, for the purposes provided for in sections 294 and 295 of the Companies Act, 1948, and to consider and, if thought fit, to approve a scheme of arrangement.

At an informal meeting last week the creditors voted unanimously in favour of the voluntary winding-up of the company.

In the Chancery Division on Monday last Mr. Justice Roxburgh granted a 14-day adjournment of the petition for the compulsory winding-up of the company. He said that he was not prepared to grant any further adjournment, and at the end of 14 days he would almost certainly either make a compulsory order or dismiss the petition.

Bankruptcies

R. P. Dyke and **G. J. Roberts,** lately carrying on business in co-partnership as Eastern Telectrics, at 54, Waterloo Road, Norwich, electrical engineers.—Receiving order made 18th February on debtors' own petition.

G. B. Barnes, 23, Front Street, Brampton, Cumberland, trading as A.B.C. Electrical Co., radio and electrical engineer.—First dividend of 7s 8d in the £, payable at the Official Receiver's office, 14, Lowther Street, Carlisle.

W. H. Rosindale, Rigg Mill, Stainsacre, Whitby, Yorks., electrician, lately carrying on business as an electrical contractor at 12 and 14, Paragon Arcade, Paragon Street, Hull.—Last day for receiving proofs for dividend 6th March. Trustee, Mr. S. D. Moore, 4, Silver Street, Hull.

J. F. Lighton and **A. R. White,** trading as Heathers at 737, Sidcup Road, New Eltham, London, S.E.9, and 119, Old Dover Road, Blackheath, S.E.3, cycle, radio and electrical dealers.—First and final dividend of 2s 1½d in the £, payable on and after 9th March at 1, John Street, Bedford Row, London, W.C.1.

P. Thomas, lately carrying on business at 4, New Street, Ledbury, Herefordshire, radio and electrical engineer.—Supplemental dividend of 1½d in the £, payable at the Official Receiver's office, Somerset House, 37, Temple Street, Birmingham, 2.

O. E. Harford, Mount Charles Road, St. Austell, Cornwall, electrical contractor and dealer.—Trustee, Mr. J. W. Shaffery, 4, Tregarne Terrace, St. Austell, released 23rd January.

H. F. Mouncey, 4, Cromer Road, Tooting, London, S.W.17, electrical engineer.—Order made 15th January granting discharge subject to bankrupt consenting to judgment for £200 and £1 10s costs, payable as to £100 within seven days and the balance by monthly instalments of £3.

Liquidations

Truvox Holdings, Ltd.—Winding up voluntarily. Liquidator, Mr. H. Moore, Bucklersbury House, Bucklersbury, London, E.C.4, appointed 12th February.

F. E. Hayter & Co., Ltd., electrical installation contractors, 15, The Mall, Ealing Broadway, London, W.5.—Winding up voluntarily. Liquidator, Mr. C. J. Saunders, 15, The Mall, Ealing Broadway, London, W.5, appointed 16th February.

Injection Moulding

An injection moulding machine, claimed to be the largest built in this country, was recently installed in the Southend works of Ekco Plastics, Ltd., and is now in full operation. Designed and built by R. H. Windsor, Ltd., of Surbiton, the 73-ton machine, the AP 335, is fitted with an Autoplas preplasticising unit. It has a capacity of 420 lb of polystyrene per hour and the swept volume of the induction stroke is 335 cu in of plastic material or approximately 210 oz of polystyrene.

Over 53 kW is required for heating, and two 720 r.p.m. motors are fitted to drive pumps. A 150 h.p. Newman motor drives two Vickers-Armstrong pumps delivering 92 and 48 gal/min at 2,000 p.s.i., and a 16 gal/min, 3,000 p.s.i. Vickers-Armstrong pump is driven by a 25 h.p. Crompton Parkinson motor. The machine is at present moulding polystyrene inner linings for the latest Frigidaire refrigerator, the model MZ-33. Large articles of this nature have previously been produced in thermoplastics by forming sheets to the required shape and drilling or punching where necessary. These assemblies, weighing up to about 12 lb, can now be produced at a single operation.

Large injection moulding machine in the Ekco factory

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1949

4871. United Kingdom Atomic Energy Authority.—Nuclear fuel elements. 17th February, 1950. (809671.)

1954

18915. Automatic Telephone & Electric Co., Ltd.—Electrical circuits including transistor devices. 21st June, 1955. (809852.)

20013/4. English Electric Co., Ltd.—Clothes drying machines. 1st July, 1955. (809943/4.)

27319. Reyrolle & Co., Ltd., A.—High voltage switchgear. 16th September, 1955. (809923.)

33612. Metropolitan-Vickers Electrical Co., Ltd.—Saturable core reactance devices. 11th November, 1955. (809742.)

1955

4588. Hohner, A. G. M.—Device for the conversion of mechanical into electrical oscillatory energy, particularly for electrical musical instruments. 16th February, 1955. (809853.)

20733. Landis & Gyr A.G.—Three-phase four-wire induction meter. 18th July, 1955. (809924.)

22684. Siemens-Schuckertwerke A.G.—Dry rectifier devices. 5th August, 1955. (809925.)

25902. Sylvania Electric Products, Inc.—Automatic assembly apparatus. 9th September, 1955. (809779.)

31185. English Electric Co., Ltd.—Radio receiving arrangements. 10th July, 1956. (809928.)

34320. General Electric Co., Ltd.—Calculating devices. 30th November, 1956. (809930.)

35973. Santon, Ltd.—Electrically operated thermal storage water heaters. 17th December, 1956. (809850.)

1956

995. Sunbeam Corporation.—Electric cooking device. 11th January, 1956. (809858.)

1988. Standard Telephones & Cables, Ltd.—Connecting the ends of wires. 18th January, 1957. (809832.)

2458. United Kingdom Atomic Energy Authority.—Production of refractory vessels. 16th January, 1957. (809833.)

4757. General Electric Co.—Apparatus for making rods or tubes by compacting pulverulent material. 15th February, 1956. (809792.)

6415. Standard Telephones & Cables, Ltd. (Laboratorie Centrale de Telecommunications S.A.).—Electrical systems for sorting messages. 1st March, 1956. (809680.)

13747. British Dielectric Research, Ltd.—Electric capacitors. 2nd May, 1957. (809839.)

13874. Licentia Patent-Verwaltungs-G.m.b.H.—Auto-self-exciting transductor. 4th May, 1956. (809746.)

14539. Standard Telephones & Cables, Ltd.—Mounting of electronic circuit components. 3rd May, 1957. (809840.)

14731. General Electric Co.—Water demineralising units particularly for domestic supply systems. 11th May, 1956. (809685.)

14960. Dole Valve Co.—Thermostatic electric switching devices. 14th May, 1956. (809686.)

15980. Oliveira, A. R. De.—Rotary electric current distributors. 23rd May, 1956. (809688.)

16984. Grigsby-Allison Co., Inc.—Rotary switch assemblies. 1st June, 1956. (809864.)

21501. Smith & Sons (England), Ltd., S.—Time controlled electric switches. 20th June, 1957. (809867.)

22902. British Insulated Callender's Cables, Ltd.—Electrical conductor. 24th July, 1957. (809868.)

23640. Powers-Samas Accounting Machines, Ltd.—Electric accumulators. 14th June, 1957. (809699.)

24556. Philips Electrical Industries, Ltd.—Television picture recording apparatus. 10th August, 1956. (809750.)

25284. General Electric Co., Ltd., Farmer, E. D., and McConalogue, D. J.—Aerial systems. 13th August, 1957. (809751.)

26074. Libbey-Owens-Ford Glass Co.—Method of removing an electrically conducting film. 27th August, 1956. (809936.)

26550. Pye, Ltd.—Deflection coils for cathode ray tubes or the like. 30th August, 1957. (809937.)

27000. Ateliers de Constructions Electriques de Charleroi.—Electric light fittings. 4th September, 1956. (809801.)

27026. British Thomson-Houston Co., Ltd.—Electronic apparatus. 4th September, 1957. (809938.)

27333. Siemens-Schuckertwerke A.G.—Hall voltage generators. 6th September, 1956. (Addition to 784885.) (809970.)

27402. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 14th August, 1957. (809870.)

27464. Standard Telephones & Cables, Ltd.—Automatic telecommunication exchanges. 7th September, 1956. (809871.)

29021. Compagnie Electro-Mecanique.—Electrical contactors. 21st September, 1956. (809703.)

31639. Collins Radio Co.—Frequency rejection system for electron mechanical filter. 17th October, 1956. (809707.)

33247. British Thomson-Houston Co., Ltd.—Electronic oscillators. 16th October, 1957. (809974.)

33724. Sperry Rand Corporation.—Signal synchroniser. 5th November, 1956. (809849.)

34098. Cole, Ltd., E. K., and Clarke, R. L.—Television receivers. 8th November, 1957. (809876.)

35616. General Electric Co., Ltd.—Braking arrangements for electric motors. 21st November, 1957. (809713.)

35783. Texas Instruments, Inc.—Materials for and methods of manufacturing semiconductor devices. 22nd November, 1956. (809877.)

35959. General Electric Co.—Gas turbines. 23rd November, 1956. (809811.)

36687. Mullard, Ltd.—Ultrasonic work machines. 8th October, 1957. (809977.)

1957

959. Westinghouse Electric International Co.—Processes of making aluminium clad copper wire. 10th January, 1957. (809812.)

1427. Siemens-Schuckertwerke A.G.—Motor circuitry of vehicles powered by electric motors which are supplied through rectifiers from single-phase supply systems. 14th January, 1957. (809882.)

2745. Egyesült Izzolampa es Villa-Mossagi R.I.—Cathode-ray tube. 25th January, 1957. (809914.)

3093. Erie Resistor Corporation.—Method and apparatus for soldering electrical connections. 29th January, 1957. (809883.)

3414. Boriolo, L. A.—Electric storage batteries. 31st January, 1957. (809884.)

3666. Bendix Aviation Corporation.—Radio compass employing loop sensing device. 1st February, 1957. (809885.)

3758. General Electric Co.—Current rectifier assembly. 4th February, 1957. (809982.)

5059. Compagnie Générale de Télégraphie sans Fil.—Travelling-wave tubes. 14th February, 1957. (809757.)

7373. Allmanna Svenska Elektriska A.B.—Cross field furnaces for the induction heating of workpieces. 6th March, 1957. (809759.)

9093/4. Standard Telephones & Cables, Ltd.—Travelling wave tubes. 20th March, 1957. (809951/2.)

9291. Telefunken G.m.b.H.—Vacuum-tight metal to ceramic joints. 21st March, 1957. (809915.)

9453. Philips Electrical Industries, Ltd.—Rectifier circuit arrangements. 22nd March, 1957. (809817.)

10062. Sunrod Manufacturing Corporation.—Electrode clamp. 27th March, 1957. (809986.)

13259. Kanthal A.B.—Apparatus for filling sheathed electrical resistance elements with granular insulating material. 25th April, 1957. (809991.)

13873. Standard Telephones & Cables, Ltd.—Printed circuit solder coating. 1st May, 1957. (809724.)

14419. Telefonaktiebolaget L. M. Ericsson.—Contact spring sets for electromagnetic switching devices. 6th May, 1957. (809889.)

15527. Bosch G.m.b.H., R.—Electrical installations for mechanically propelled vehicles. 16th May, 1957. (809890.)

18602. Siemens-Schuckertwerke A.G.—Circuit arrangements for operating synchronous generators. 12th June, 1957. (809893.)

25266. Standard Telephones & Cables, Ltd.—Electromagnetic relays. 9th August, 1957. (Addition to 760376.) (810346.)

35099. Electrolux Corporation.—Vacuum cleaners. 11th November, 1957. (810369.)

1958

9615. Algemene Kunstzijde Unie N.V.—Electric driving systems. 17th May, 1956. (Divided out of 809374.) (809819.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 18th March:

Hobart (design). No. B773,765. Class 7. Electrical food preparing machinery.—Hobart Manufacturing Co., Ltd., Hobart Corner, New Southgate, London, N.11.

Oakada. No. B781,102. Class 8. Electric shaving instruments.—S. P. Kramer, trading as Rosley Products, 88, Walm Lane, London, N.W.2.

Nos. 742,721, 742,733 and 742,745 (design). Class 9. Switchboards, switchgear, distribution boards, transformers, circuit-breakers, rectifiers, convertors, condensers, alternators, frequency changing apparatus and insulated cable wire; radio aerials; component parts of radio receiving apparatus; weighing apparatus and parts; gauges, temperature-recording apparatus, electric welding apparatus (not machines), electro-plating apparatus, mobile trailer fire pumps and clothing for the protection of industrial operatives against accident or injury.—George Cohen, Sons & Co., Ltd., 600, Wood Lane, Shepherds Bush, London, W.12.

Bimbi. No. 781,460. Class 9. Electric flat irons.—Oliver Industries, Ltd., 80, Gloucester Road, Croydon, Surrey.

Servax. No. 782,552. Class 9. Insulated electric cables.—Duratube & Wire, Ltd., 39, Dover Street, London, W.1.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 9th MARCH

Birmingham.—College of Technology, 6 p.m. I.E.E. South Midland Supply and Utilisation Group. "The Design and Performance of the Gas-Filled Cable System," by E. P. G. Thornton and D. H. Booth.

Bournemouth.—Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. "Heat Pumps," by J. A. Sumner.

Cardiff.—South Wales Institute of Engineers, 6 p.m. I.E.E. Western Centre. "Results of Full Scale Stability Tests on the British 132 kV Grid System," by Dr. F. Busemann and W. Casson and "The Organisation for Large Scale Grid System Tests," by Dr. F. H. Last, E. Mills and N. D. Norris.

Ipswich.—Electric House, 7 p.m. I.E.E. East Anglian Sub-Centre. "Recent Developments in Medium Voltage H.B.C. Fuse Links," by R. H. Dean.

London.—2, Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Informal meeting. Discussion on "Need British Standards Be Modified to Obtain Trade Abroad?", opened by T. M. H. Stubbs.

Savoy Hotel, W.C.2. Electrical Sign Manufacturers' Association. Luncheon and presentation of illuminated sign design competition prizes by Mr. Henry Brooke, M.P.

White Hall Hotel, Bloomsbury Square, W.C.1, 7.15 p.m. A.S.E.E. Central London Branch. "G.P.O. Submarine Cables," by A. W. Welsh.

Malvern.—Winter Gardens, 7.30 p.m. I.E.E. South Midland Centre. District meeting. Two students' lectures.

Middlesbrough.—Cleveland Scientific and Technical Institution, 7.15 p.m. North East Metallurgical Society. "The Development of the Tungsten Filament Lamp," by Dr. B. P. Dudding.

Newcastle-on-Tyne.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North Eastern Centre. "The Design of Electro-Mechanical Auxiliaries Directly Associated with Power-Producing Reactors," by A. E. Harwood, P. Scott and B. H. Stonehouse.

Wembley Park.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. "Wartime Evasion and Escape," by E. H. Maddox.

TUESDAY, 10th MARCH

Belfast.—Queen's University, Stranmillis Road, 6.30 p.m. I.E.E. Northern Ireland Centre. "The B.B.C. Sound Broadcasting Service on Very-High Frequencies," by E. W. Hayes and H. Page.

Bristol.—R.W.A. School of Architecture, 6.30 p.m. Institution of Heating and Ventilating Engineers, South Western Branch. Annual general meeting followed by films.

Cardiff.—Angel Hotel, 7.30 p.m. A.S.E.E. South Wales Branch. "High Fidelity Sound Reproduction."

Cheltenham.—Rotunda, 7.30 p.m. Society of Instrument Technology, Cheltenham Section. "Instrumentation on the Trans-Antarctic Expedition."

Eltham.—Eltham Green School, Queenscroft Road, S.E.9, 7.45 p.m. A.S.E.E. South East London Branch. "Radio Frequency Heating," by P. W. Ainscow.

Huddersfield.—Y.E.B., Market Street, 7 p.m. I.E.E. North Midland Graduate and Student Section. "Some Methods of Variable Speed Electric Motor Drives," by G. T. Mills.

London.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "The Laplace Transform—A Tool for the Electrical Engineer," opened by A. C. Sim.

Overseas League, Overseas House, St. James's, S.W.1, 11 a.m. E.A.W. London Branch. Twenty-fifth anniversary. Annual general meeting followed by buffet luncheon at 12.45 p.m. in the Hall of India, Overseas House. Speaker, Dr. T. E. Allibone.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon.

Manchester.—Midland Hotel, 6.45 for 7.15 p.m. I.E.E. North Western Centre. Annual dinner.

Engineers' Club, Albert Square, 7.15 p.m. Institution of Plant Engineers, Manchester Branch. Annual general meeting.

Central Library, St. Peter's Square, 6.30 p.m. Society of Instrument Technology, Manchester Section. "Electro-Magnetic Flow Meters," by L. M. Bennett.

Portsmouth.—Ministry of Labour and National Service, Lake Road, 7.30 p.m. A.S.E.E. Portsmouth and District Branch. "Stage Lighting," by F. P. Bentham.

Reading.—Technical College, 7 p.m. I.E.E. London Graduate and Student Section. Arborfield District meeting. "Stereophonic Sound," by E. W. Berth-Jones.

Sheffield.—Grand Hotel, 7 p.m. E.P.E.A. Sheffield Technical Group. Annual general meeting and film evening.

York.—Georgian House, Blossom Street, 7.30 p.m. A.S.E.E. York Branch. "Variable Speed A.C. Motors."

WEDNESDAY, 11th MARCH

Birmingham. — Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E. Birmingham Branch. "Rectifiers and Their Applications," by J. T. Whitehouse.

Bradford.—Midland Hotel, 7.30 p.m. A.S.E.E. Bradford Branch. Film of the 1958 Electrical Engineers' Exhibition with a talk by E. A. Bromfield.

Cardiff.—College of Advanced Technology, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Applications of Photo-electric Cells," by F. A. Benson.

Dundee.—Taypark Hotel, West Ferry, 7.30 p.m. Institution of Plant Engineers, Dundee Branch. Annual general meeting.

Glasgow.—39, Elmbank Crescent, 7 p.m. I.E.E. South West Scotland Sub-Centre. "Electrical Installation at Calder Hall," by N. J. Mackay and E. Hardwick.

39, Elmbank Crescent, 8 p.m. A.S.E.E. Glasgow Branch. "Group Motor Control Gear," by D. A. Thomson.

Grand Hotel, Charing Cross. Combustion Engineering Association. 10.30 a.m. "Reactor Engineering," by J. W. Ashley; 2.30 p.m. "Firing of Heavy Fuel Oil," by C. A. Roast.

Hove.—S.E.E.B., 10, Queen's Gardens, 6.30 p.m. I.E.E. Southern Centre. "Generation of Electricity in London," by H. V. Pugh.

Leeds.—Hotel Metropole, 11 a.m. Combustion Engineering Association, Northern Region. "The Personnel Angle in Boiler House Efficiency," by R. H. Thompson.

London.—Connaught Rooms, W.C.2, 7 for 7.30 p.m. I.E.E. Supply Section. Dinner-dance.

Grosvenor House, W.1, 11.30 a.m. Radio and Electronic Component Manufacturers' Federation. Annual general meeting. 12.30 for 1 p.m. Luncheon.

Luton.—Luton Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Earthing," by S. J. Emerson.

Newcastle-upon-Tyne. — Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North Eastern Section. "Microwave Strip-line Circuits for Radar Equipment," by K. Foster.

Northampton.—College of Technology, 7.15 p.m. Northampton and District Electrical Association. "T.V. Studio Lighting," by K. C. Ackerman.

Nottingham. — County Hotel, Theatre Square, 7 p.m. Institution of Plant Engineers, East Midlands Branch. Annual general meeting.

Oxford.—Southern Electricity Board, 37, George Street, 7 p.m. I.E.E. Oxford District meeting. "Zeta," by R. Carruthers.

Preston.—North Western Electricity Board, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "Computers," by Dr. R. L. Grimsdale.

Rugby.—College of Technology and Arts, 6.30 p.m. I.E.E. Rugby Sub-Centre. Annual general meeting. "Generator/Motor Problems in Pump Storage Installations," by Dr. J. H. Walker.

THURSDAY, 12th MARCH

Bath.—Pump Room, 7.15 p.m. I.E.E. Bristol Graduate and Student Section. Brains Trust. (Joint meeting with Institution of Mechanical Engineers.)

Dundee.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "The Relation between Picture Size, Viewing Distance and Picture Quality with special reference to Colour Television and Spot-Wobble Techniques," by L. C. Jesty.

Exeter.—S.W.E.B., Bedford Street, 3 p.m. I.E.E. South Western Sub-Centre. "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

Glasgow.—More's Hotel, India Street, 7.15 p.m. Institution of Plant Engineers, Glasgow Branch. Annual general meeting.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section and London Graduate and Student Section. "Coal Mining and Electricity," by A. P. Foster, "Electric Drives in the Paper Industry," by P. D. House and "Standardisation and Simplification of Switchgear," by M. J. L. Willison.

Manchester.—North Western Electricity Board, Town Hall Extension, 6 p.m. I.E.S. Manchester Centre. "Lighting in Commerce," by K. C. White.

Newcastle-upon-Tyne.—Roadway House, Oxford Street, 7 p.m. Institution of Plant Engineers, North East Branch. Annual general meeting.

Swansea.—S.W.E.B., The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "Electrical Control of Stage and Television Lighting," by F. P. Bentham.

FRIDAY, 13th MARCH

Aberdeen.—Robert Gordon's Technical College, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "The Relation between Picture Size, Viewing Distance and Picture Quality," by L. C. Jesty.

Bristol.—Hawthorns Hotel. Institution of Plant Engineers, Western Branch. Dinner and dance.

London.—Caxton Hall, Westminster, S.W.1, 6.30 p.m. E.P.E.A. Southern Meter Engineers' Technical Group. Brains Trust.

Grosvenor House, Park Lane, W., 6.30 for 7.15 p.m. Institute of Marine Engineers. Annual dinner.

Newcastle-on-Tyne. — Old Assembly Rooms, 7 p.m. I.E.E. North Eastern Centre. Annual dinner and dance.

County Hotel. Institution of Plant Engineers, North East Branch. Annual dinner and dance.

Nottingham. — A.S.E.E. Nottingham Branch. Annual ladies' evening.

Oldbury.—Tube Investments Social Club, 8 p.m. E.I.B.A. Birmingham and District Branch. Annual ball.

Port Sunlight.—Hulm Hall, 7 p.m. I.E.E. Mersey and North Wales Centre. Dinner dance.

SATURDAY, 14th MARCH

Manchester.—Café Royal. Institution of Plant Engineers, Manchester Branch. Ladies' evening.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Aberdare.—U.D.C. 20th March. Street lighting equipment. (See this issue.)

Aldridge.—U.D.C. 6th April. Street lighting equipment. Engineer and surveyor, 9, Leighswood Road.

Australia.—Southern Electricity Authority of Queensland, Brisbane. 26th March. 33 kV outdoor type switchgear. (E.S.B. 4152/59. Ten/37451.)*

Canada.—Manitoba Hydro-Electric Board, Winnipeg. 17th March. Local and supervisory control, metering, relaying and communications equipment. (E.S.B. 4797/59. Ten/37637.)*

Colombia.—Secretaria Gral. de la Empresa Colombiana de Aerodromes, Bogota. 15th March. Radio transmitter equipment. (E.S.B. 4164/59. Ten/37545.)* Radio telephone and radio telegraphic transmitters. (E.S.B. 4157/59. Ten/37544.)*

Durham.—County Council. Electrical installation and electric lift at new county offices. (See this issue.)

India.—Madras State Electricity Board. 16th March. Conductors and galvanised steel earth wire and accessories for 66 kV lines. (E.S.B. 4982/59. Ten/37648.)*

Singareni Collieries Co., Ltd., Hyderabad. 17th March. Gate-end boxes. (E.S.B. 4059/59. Ten/37474.)*

Kanpur Electricity Supply Administration. 10th March. One 150,000 lb/hr water tube boiler. (E.S.B. 22556/59. Ten/28096A.)* One 15,000 kW turbo-alternator, condensing plant and auxiliary apparatus. (E.S.B. 3681/59. Ten/37652.)* (Re-issued calls for tenders.)

Iraq.—Directorate General of Municipalities, Baghdad. 14th March. Transformers, etc., for Sulaimaniyah Water and Power Board. (E.S.B. 4293/59. Ten/37462.)*

Litherland.—U.D.C. 23rd March. Electric lamps and sodium tubes (schedule 9), for one year. Surveyor, Town Hall.

New Zealand.—Wellington Corporation. 16th March. Cable joints and terminations. (E.S.B. 4201/59. Ten/37465.)*

G.P.O., Wellington. 23rd March. Insulated telephone cable. (E.S.B. 4313-4/59. Ten/37491-2.)* 26th March. Valves. (E.S.B. 4086/59. Ten/37410.)* 31st March. Switchboard cords and operators' cords. (E.S.B. 4134/59. Ten/37448.)* Insulating tape. (E.S.B. 4315/59. Ten/37480.)* Capacitors, induction coils, cords, instrument jacks, keys, lamps, plugs, relays and telephones. (E.S.B. 4312/59. Ten/37508.)*

Central Waikato Electric Power Board, Hamilton. 31st March. Two 5,000 kVA transformers. (E.S.B. 4271/59. Ten/37478.)*

Pakistan.—Posts and Telegraphs Department, Karachi. 11th March. Testing equipment for cable. (E.S.B. 4742/59. Ten/37568.)*

Rhodesia and Nyasaland.—Bulawayo City Council. Street traffic signals. (E.S.B. 4145/59. Ten/37561.)*

Federal Tender Board, Causeway. 13th March. Electric lamps. (E.S.B. 4699/59. Ten/37571.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 11th March. Insulated cable. (E.S.B. 4613/59. Ten/37566.)*

Pretoria City Council. 17th March. 33 kV circuit-breaker. (E.S.B. 4746/59. Ten/37572.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Coventry.—Education Committee. Recommended. Electrical heating installation in sixth hostel block of City Training College (£3,186).—Thompson Electrical Co.

Durham.—County Council. Electrical installation at the Assize Courts (£2,254).—J. Paterson & Co. Electrical work at Ivy House, Sedgefield (£2,706).—North of England Engineering & Electrical Co.

Southampton.—South West Metropolitan Regional Hospital Board. Recommended. Electrical installation work in new maternity unit at Southampton General Hospital (£2,882).—Groves & Co. Lift (£5,747).—Evans Lifts.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aberdeen.—Out-patients' block for Royal Aberdeen Hospital for Sick Children; C. C. Wright, architect, 1, Albyn Place.

Two multi-storey blocks of flats, City Centre; city architect.

Aldershot.—Crematorium, Aldershot Park; borough engineer, Town Hall.

Brandon.—Proposed new factory; Margy Belts, Ltd., Brandon.

Brentwood.—Houses (68), Hutton estate; C. N. Booth, clerk, Council Offices.

Cleadon (Co. Durham).—Houses (70); Wimpey & Co., Ltd., contractors, Fenwick Terrace, Newcastle-on-Tyne.

Colchester.—Craft block, Royal Grammar School; John Strong, architect, 137, High Street, Billericay.

Deal.—Pavilion, concert hall, bus station, in connection with scheme for redevelopment of town centre; borough surveyor, Queen Street.

Dudley.—Flats, Wren's Nest redevelopment (126) and Rosland Farm (27), and additions to Rosland School and Sledmere Schools; borough architect, 5, Ednam Road.

Durham.—Houses (22); Bell & Ridley, Ltd., builders, North Road, Durham.

Ellesmere Port.—Church of St. Thomas, Chester Road, Whitby; Cartwright Bros., Ltd., builders, Hooton, Wirral.

Gateshead.—Shops and supermarket on the site of the Scala Cinema, High Street, for Laws Stores, Ltd.; Mauchlen, Weightman & Elphick, architects, 12, Saville Row, Newcastle-on-Tyne.

Gloucester.—Factory, Brockworth area; British Nylon Spinners, Ltd., 25, Upper Brook Street, London, W.1.

Gravesend. — Departmental store (£100,000); W. J. Reed, architect, 99, Leman Street, London, E.1.

Heywood.—Houses (96), Heady Hill; W. R. Parker, town clerk, Municipal Buildings.

Hillmorton.—Old people's home (£52,870), Abbots Farm estate; county architect, Warwick.

Inverness.—College of Further Education, Longman estate (£191,190); county architect, The Castle, Inverness.

Kerrier.—Houses (59), Mabe site; W. Thomas, clerk, Council Offices, The Willows, Helston, Cornwall.

Leicester.—Erection of Goldhill Secondary Modern Boys' School, Knighton Lane East; J. H. Lloyd Owen, city architect, 10, Loseby Lane.

London.—Factory for C. A. Coutts & Co., Ltd., Brewery Road, Holloway; F. G. Minter, Ltd., builders, 4, Buckingham Gate, S.W.1.

Nuclear engineering laboratory, Queen Mary College, Stepney; J. Jarvis & Sons, Ltd., builders, 239, Vauxhall Bridge Road, S.W.1.

Twenty-nine storey office block, Little Road area; Atrium Properties, Ltd., 28, South Audley Street, W.1.

Longbenton (Northumberland).—Houses (150); A. E. Sweetman, U.D.C. surveyor.

Merthyr Tydfil.—Omnibus garage; borough engineer.

Middlesbrough.—Proposed Stockton Road R.C. (Special Agreement) Secondary School; K. J. Caton, education architect, Woodlands Road, Middlesbrough.

Houses (26), Easterside; C. W. Athey & Sons, builders, Windsor Road, Middlesbrough.

North Riding.—Extensions to Richmond Grammar School (£71,000); Moody Brothers, builders, Northallerton.

Northumberland.—Proposed old people's home at Morpeth; county architect, County Hall, Northallerton.

Oldham.—Houses (139), Fitton Hall estate extension; Cameron & Middleton, Council's quantity surveyors, 21, Queen Street, Oldham.

Peterborough.—Four-bay addition to engineering block of Technical College; Portess & Richardson, architects, Cathedral Gateway Chambers.

Peterlee (Co. Durham).—Proposed new factory for Peterlee Development Corporation; W. H. Scott, chief architect.

Poole.—Large extensions to Kemp Welch Modern School (£104,000); Dorset county architect, County Hall, Dorchester.

Reading.—Flats (30), Kendrick Road; W. J. Brown & Son, Ltd., builders, Armour Road, Tilehurst.

Runcorn.—Houses (203); T. J. Lewis, clerk, Town Hall.

Sandbach.—Houses (30), Crewe Road; H. J. Rees, surveyor, Council Offices, Crewe Road, Sandbach, Cheshire.

Spennymoor.—Houses (134), Middlestone Moor estate; Gray & Partner, architects, 52, Camden Street, North Shields.

Sunderland.—Extensions to main office block, Southwick engine works; Brims & Co., Ltd., contractors, City Road, Newcastle-on-Tyne.

Swadlincote.—Houses (44), Robinsons Road/Meadow Lane scheme; surveyor, Bank House, Midland Road.

Tenby.—Grammar-modern school; W. Barrett, architect, County Offices, Haverfordwest.

Thornaby-on-Tees.—Houses (70), Humphrey's Field; J. L. Watson, borough engineer.

Torquay.—Two nine-storey blocks of flats, Braddons Hill Road; John M. Liddell, Vane Hill Road.

Welwyn Garden City. — R.C. church; Charles Brightman & Son, Ltd., builders, Ebury Road Works, Watford.

Weston-super-Mare. — Houses (113), Bournville estate; Banks, Wood & Partners, architects and surveyors, 41, Alma Road, Clifton, Bristol, 8.

Whitby.—Modern school; J. H. Napper, architect, 56, Eldon Place, Newcastle-on-Tyne.